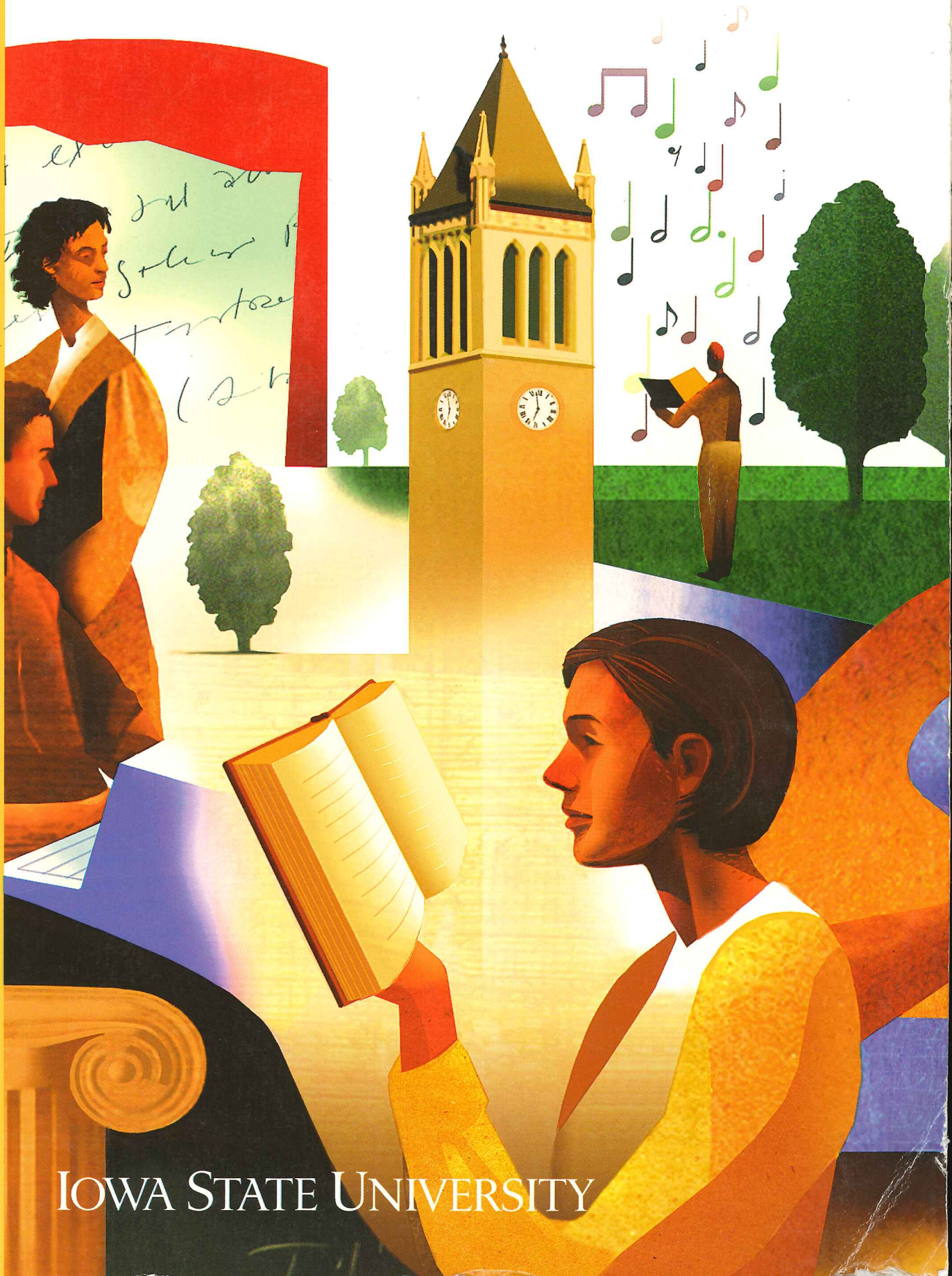


Iowa State University Bulletin

Courses and Programs 1999-2001



IOWA STATE UNIVERSITY

Iowa State University Bulletin

Courses and Programs 1999-2001



***Iowa State University
of Science and Technology
Ames, Iowa***

Iowa State University Bulletin
Vol. 23, No. 4 April 1999
(USPS 348-950)

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Contents



3 Academic Calendar

4 The University

- 7 Administration of Iowa State University
- 8 Admissions and Records
- 14 Extended and Continuing Education
- 17 Fees and Expenses
- 20 Student Financial Aid
- 22 Student Housing
- 24 Student Services
- 30 Student Life
- 33 Research Organizations
- 37 Academic Life
- 52 Designators

53 Colleges and Curricula

- 57 College of Agriculture
- 72 College of Business
- 75 College of Design
- 81 College of Education
- 87 College of Engineering
- 97 College of Family and Consumer Sciences
- 104 College of Liberal Arts and Sciences
- 109 College of Veterinary Medicine
- 112 Graduate College

120 Courses and Programs

351 The Faculty

379 Index

Academic Calendar 1999-2001

Fall Semester 1999

Classwork begins,
Monday, August 23

University holiday, offices closed
Monday, September 6

Thanksgiving, classes recessed
Friday, November 19, 11 p.m.

University holidays, offices closed
Thursday and Friday, November 25 and 26

Classes resume,
Monday, November 29, 7 a.m.

Commencement,
Friday and Saturday, December 17 and 18

University holidays, offices closed
Thursday and Friday, December 23 and 24

Spring Semester 2000

University holiday, offices closed
Friday, December 31

Classwork begins,
Monday, January 10

University holiday, offices closed
Monday, January 17

Spring vacation, classes recessed
Friday, March 10, 11 p.m.

Classes resume,
Monday, March 20, 7 a.m.

VEISHEA,
Friday-Sunday, April 14-16 (no class recess)

Commencement,
Friday and Saturday, May 5 and 6

Summer School 2000

Classwork begins, Session I
Monday, May 15

University holiday, offices closed
Monday, May 29

Classwork begins, Session II
Monday, June 12

University holiday, offices closed
Friday, July 4

Commencement,
Saturday, August 5

Fall Semester 2000

Classwork begins,
Monday, August 21

University holiday, offices closed
Monday, September 4

Thanksgiving, classes recessed
Friday, November 17, 11 p.m.

University holidays, offices closed
Thursday and Friday, November 23 and 24

Classes resume,
Monday, November 27, 7 a.m.

Commencement,
Friday and Saturday, December 15 and 16

University holidays, offices closed
Monday and Tuesday, December 25 and 26

Spring Semester 2001

University holiday, offices closed
Monday, January 1

Classwork begins,
Monday, January 8

University holiday, offices closed
Monday, January 15

Spring vacation, classes recessed
Friday, March 9, 11 p.m.

Classes resume,
Monday, March 19, 7 a.m.

VEISHEA,
Friday-Sunday, April 13-15 (no class recess)

Commencement,
Friday and Saturday, May 4 and 5

Summer School 2001

Classwork begins, Session I
Monday, May 21

University holiday, offices closed
Monday, May 28

Classwork begins, Session II
Monday, June 18

University holiday, offices closed
Wednesday, July 4

Commencement,
Saturday, August 11

The University

Iowa State University was established in 1858 as one of the first land-grant colleges in the United States. As a land-grant institution, Iowa State's educational philosophy is guided by four defining qualities: access regardless of race, creed, gender, or economic background; the marriage of practical and liberal education; emphasis on both applied and basic research; and service to the people of the state through the delivery of knowledge that improves the quality of life. Iowa State's mission statement reflects our institutional commitment to those qualities.

Mission, role and scope statement

(Approved by the State Board of Regents, November 1989)

Iowa State University of Science and Technology is a public land-grant institution serving the people of Iowa, the nation, and the world through its interrelated programs of instruction, research, extension, and professional service. With an institutional emphasis upon areas related to science and technology, the University carries out its traditional mission of discovering, developing, disseminating, and preserving knowledge.

Iowa State University provides high quality undergraduate programs across a broad range of disciplines, as befits the institution's stature as a university. In its dedication to excellence in teaching, the University strives to instill in its students the discernment, intellectual curiosity, knowledge and skills essential for their individual development and their useful contribution to society. A common goal of undergraduate education is to assure that all students, regardless of disciplinary major, acquire literacy in science and technology, an understanding of humane and ethical values, an awareness of the intellectual, historical, and artistic foundations of our culture, and a sensitivity to other cultures and to international concerns. Consonant with its role as a teaching and research institution, Iowa State University has a strong commitment to graduate education that, at both the master's and doctoral levels, emphasizes the development of professional, research, and scholarship skills.

As an integral part of the learning process, Iowa State University fosters the discovery and dissemination of new knowledge by supporting research, scholarship, and creative activity. The University also uses existing knowledge to address problems and issues of concern to the state of Iowa in particular, as well as to the national and global community. The University's research and scholarly endeavors are supported by public and private resources and are conducted in an environment of open scientific inquiry and academic freedom.

Extension, professional service, and continuing education activities are conducted through innovative and effective outreach programs that provide the people of Iowa, and beyond, with practical knowledge and information derived from leading instructional and research efforts at Iowa State University and elsewhere. Through its outreach programs, the University stimulates and encourages progressive change.

Iowa State University enrolls academically qualified students who represent diverse age groups, socio-economic levels, racial ancestries, ethnic heritages, and international cultures, and who provide a gender balance. Through the use of a variety of educational opportunities, advanced instructional technologies, and student services, the University supports the development of both traditional and non-traditional students, preparing them for citizenship and life-long learning in a rapidly changing world.

Finally, Iowa State University participates in international efforts to alleviate world hunger and poverty, to prepare students and faculty to be productive and responsible citizens of the world, and to contribute to increased cultural, educational, economic, scientific, and socio-political interchange and understanding between and among Iowans and other members of the world community.

Role Statement

The role of Iowa State University is defined by the institution's status as the state of Iowa's land-grant university and by its relationship to the other institutions of higher education within Iowa.

- Iowa State University must strive to develop and maintain instruction, research, extension, and professional service programs that fulfill the responsibilities of a major land-grant institution.

- Iowa State University shares with the other public institutions of higher education within Iowa the joint responsibility of providing a full range of high quality educational opportunities. Coordination among these institutions with respect to programs, clientele, and geographic areas is necessary to ensure that the priority needs of all Iowans are addressed and to avoid unnecessary duplication.

- Iowa State has a statewide system for extension education and information dissemination.

- Iowa State continues to be a leading higher education institution with institutional emphasis on science and technology.

- Consistent with its historic role, Iowa State University contributes to the economic development of the state of Iowa by attracting public and private organizations seeking proximity to leading authorities in particular fields, by

participating in technology transfer, and by assisting efforts to strengthen and diversify the economic base of Iowa.

- Iowa State University assumes responsibility for helping to protect, maintain and improve Iowa's natural resources through the discovery and diffusion of knowledge and technology.

Scope Statement

Consistent with the university's role and mission statements, the current scope of Iowa State University is described below.

- Iowa State University of Science and Technology, a broad-based university with an orientation towards science and technology, has sufficient scope and depth in its instruction, research, and extension and professional service functions to enable it to continue to be a distinguished land-grant university. In addition to its undergraduate and graduate work in the physical, biological, mathematical, and social sciences, it will maintain and develop strong undergraduate programs in the arts and humanities, and will offer such master's and Ph.D. programs in this area as are justified to meet the needs of the state of Iowa and to maintain the overall strength and desirable balance of the university as a whole.

- In Iowa State University's professional programs, principal emphasis will be given to the maintenance and development of strong programs in the sciences, agriculture, engineering, veterinary medicine, design, education, business, and family and consumer sciences. Interdisciplinary programs are offered that seek to combine the perspectives and methods of more than one discipline to better address the questions and problems confronting Iowa, the nation, and the world. The international efforts of Iowa State University are to be expanded and enhanced.

- Iowa State University will offer no major undergraduate or graduate programs in law, library science, human medicine, dentistry, pharmacy, nursing, hospital administration, occupational therapy, physical therapy, or speech pathology.

- Future programs will be determined by the continuing assessment of existing programs and of developing needs. Programs will be curtailed or eliminated when the assessment of need and resources dictates that the resources could be better used for other programs. The university approaches the addition of new programs with considerable caution.

Generally, new programs are fashioned out of existing programs in response to developing needs. But if the university is to remain vital, it must be prepared and able to develop, at appropriate times, new programs that are within its general mission and that meet the changing needs of the students and society.

Iowa State's values

- Iowa State is dedicated to service, with pride in its high standards.
- It embraces the values of honesty, integrity, hard work, cooperation, friendliness, and human concern. And it is dedicated to fostering an environment in which differences in people, such as nationality, race, gender, religion, cultural background, physical ability, and sexual orientation, are respected and mutual understanding is promoted. (See non-discrimination and affirmative action policy below.)
- Iowa State University encourages the highest aspirations and intellectual development of all students, faculty, and staff; it challenges them in the quest for new knowledge and its transmission, preservation, and application for the betterment of society.
- Inspired by the beauty of its surroundings, Iowa State is a community dedicated to intellectual excitement and creativity, where ideas are vigorously debated and rigorously tested. The community understands the value of science and technology in today's world, and it appreciates the richness of human experience expressed through the arts and humanities. The Iowa State community reaches out to translate knowledge into action, and to serve as a resource for strengthening and enhancing the social, economic, and physical environment of the state, the nation, and the world.

Non-discrimination and affirmative action policy

Iowa State University is committed to developing and implementing a program of nondiscrimination and affirmative action, a responsibility the university accepts willingly because it is the right and just thing to do. Because an educational institution exposes the youth of Iowa and of the nation to a multitude of ideas that strongly influence their future development, it is an area of our society where removing barriers is critical. We insist on promoting the concept of inclusion and participation.

This commitment is part of a larger commitment to developing a safe and supportive climate for all members of the ISU community in classrooms and laboratories, in offices, in the residence hall system, and throughout the campus. Iowa State University recognizes that a non-discriminatory environment complements a commitment to academic inquiry and intellectual and personal growth.

The goal is to provide a non-discriminatory work environment, a non-discriminatory living and learning environment and a non-discriminatory environment for visitors to the campus. Iowa State University herein recommit itself to comply with all federal and state laws, regulations, and orders, including the policies of the Iowa Board of Regents, which pertain to nondiscrimination and affirmative action.

All administrators and personnel providing input into administrative decisions are directed to ensure that all decisions relative to employment, conditions of employment and access to programs and services will be made without regard to race, color, age, religion, national origin, sexual orientation, sex, marital status, disability, or status as a U.S. Vietnam Era Veteran. Exceptions to this directive may be made in matters involving bona fide occupational qualifications, business necessity, actions designed to eliminate workforce underutilization, and/or where this policy conflicts with federal and state laws, rules, regulations, or orders. Iowa State University does not and will not tolerate unlawful discrimination. Iowa State will recruit, hire, train and promote persons without regard to race, color, religion, sex, national origin, age, disability, veteran status, marital status, or sexual orientation. Iowa State University will base employment decisions so as to further the principle of equal employment opportunity and diversity.

No otherwise qualified person will be denied access to, or participation in, any program, activity, service, or the use of facilities on the basis of factors previously enumerated. Reasonable accommodation will be made to facilitate the participation of persons with disabilities in all such activities consistent with applicable federal and state laws, orders and policies.

Further, all supervisory personnel will be responsible for maintaining an environment that is free of racial, ethnic or sexual abuse and harassment. The University has adopted policies and procedures on Racial and Ethnic Harassment and Sexual Harassment. Copies of these policies and procedures may be obtained from the Affirmative Action Office, at the address listed below. Acts by anyone that adversely affect another person's employment, conditions of employment, academic standing, receipt of services, and/or participation in, or enjoyment of, any other activity, will be regarded as a violation of university policy and thereby be subject to appropriate disciplinary action. Retaliation against persons filing complaints, for bringing the violation of this policy forward for review, or for assisting in a review, pursuant to a filed complaint or grievance, is prohibited.

Iowa State University's commitment to nondiscrimination and affirmative action is of the highest priority and is to be adhered to as such. It applies to all university-sponsored programs and activities as well as those that are conducted in cooperation with the university.

Iowa State University has designated Carla Espinoza as the affirmative action officer and assigns overall program responsibility to her as the Director of Affirmative Action. Questions regarding complaints and/or compliance with affirmative action or equal opportunity should be directed to:

Carla Espinoza
318 Beardshear Hall
Iowa State University
Ames, IA 50011-2038
515-294-7612.



Iowa State's points of pride

The first electronic digital computer was designed by Iowa State math and physics professor John Vincent Atanasoff and graduate student Clifford Berry. Their invention, the ABC computer, built in the late 1930s, has been called the most important technological innovation of the 20th century, and is an excellent example of the ongoing spirit of innovation and advancement at Iowa State. Today the Iowa State community benefits from that innovation through Project Vincent, a computing system that provides students with powerful software for class work and research, e-mail access, space for their own Web pages and a speedy on-ramp to the Internet.

- More than 16,000 workstations on campus are networked with access to Internet and vBNS, fast new connections that allow work with complex computer models and links to supercomputers throughout the nation. Excellent computing facilities and Internet services to students have landed Iowa State on *Yahoo!Internet Life* magazine's "100 Most Wired Colleges" list.

- Iowa State's C2 is one of the world's most advanced computer virtual reality rooms.

As evidence of the university's reputation for excellence, Iowa State is one of only 62 major research universities in the United States and Canada named to the prestigious Association of American Universities.

Iowa State consistently ranks in the top four percent of the private and public institutions enrolling National Merit Scholars.

At Iowa State, more than 500 student-run organizations and academic clubs offer between 7,000 and 8,000 student leadership positions, allowing students to exercise and develop all of their skills and interests.

Our nationally and internationally renowned professors teach classes for both majors and non-majors, extending students' opportunities to study with leaders in a variety of disciplines.

- Every state and more than 100 foreign countries are represented in the student body, exposing students to ideas from other cultures both in and out of the classroom.

· Our facilities include 154 campus buildings on a campus ranked as one of the 25 most beautiful in the nation. State-of-the-art facilities include the Durham Center for Computation and Communication, Lied Recreation/Athletic Center, Molecular Biology Building, and the Center for Designing Foods to Improve Nutrition. The new millennium will see the completion of a massive new Engineering Teaching and Research complex and a new College of Business building.

· Our internationally recognized graduates include George Washington Carver, an agricultural scientist; and Carrie Chapman Catt, a feminist who helped win American women the right to vote. Alumni of Iowa State include CEOs of Fortune 500 corporations, Pulitzer Prize-winning journalists, internationally recognized scientists, and elected government leaders.

Iowa State's history

Iowa State is one of the nation's oldest and most respected land-grant universities. Created by the Iowa General Assembly in 1858, the Iowa Agricultural College and Model Farm was designated the nation's first land-grant college when Iowa became the first state to accept terms of the federal Morrill Act in 1864.

The school, which was the first land-grant institution to be co-educational from the beginning, opened its doors in the fall of 1868. A class of 26 was graduated at the first commencement in 1872. Graduate study was offered almost as soon as classes began, and

the first graduate degree was conferred in 1877. Experimentation and research also started early in agriculture, home economics, engineering, science, and veterinary medicine.

As Iowa State adapted the land-grant philosophy to the changing needs of the 20th century, it adopted special teaching responsibilities in science and technology, an extension education program throughout the state, and extensive research interests to advance the frontiers of learning. Since 1959, it has been known as Iowa State University of Science and Technology.

Strategic Plan - to become the best.

Iowa State aspires to be the premier land-grant institution in the nation. Its strategic goals are: strengthen undergraduate teaching, programs and services; strengthen graduate, professional, and research programs; strengthen outreach and extension efforts; sustain and enhance an intellectually stimulating environment and a supportive university community; establish international leadership in the integration and effective use of information technology and computation services; strengthen initiatives to stimulate economic development, with a special emphasis on environmental stewardship and enhancing human resources and the quality of life.

The laws of the United States and of the State of Iowa provide for resident academic instruction, research, and extension education, and for the management of Iowa State University

of Science and Technology. The university and two other state educational institutions of higher learning are governed by the State Board of Regents, composed of nine members nominated by the Governor of Iowa and confirmed by the Senate of Iowa. The immediate regulation and direction of the academic, research, and extension activities of the university are delegated by the Board of Regents to the president and faculty of the university. The board appoints an executive director with overall responsibility for the administration of the central office of the board located in Des Moines.



Administration of Iowa State University

State Board of Regents

Owen J. Newlin, President
Frank J. Stork, Executive Director

Terms expire June 30, 1999

James H. ArensonCedar Rapids
Owen J. NewlinDes Moines
Nancy C. PellettAtlantic

Terms expire June 30, 2001

Ellengray G. Kennedy..... Bancroft
Roger L. Lande..... Muscatine
Beverly A. SmithWaterloo

Terms expire June 30, 2003

Lisa E. Ahrens.....Osage
David J. Fisher..... West Des Moines
Dr. Clarkson L. Kelly, JrCharles City

Officers of Administration

Martin C. Jischke, Ph.D., President of the University

Provost

Warren R. Madden, M.B.A., Vice President for Business and Finance

Murray M. Blackwelder, M.P.A., Vice President for External Affairs

Thomas L. Hill, Ph.D., Vice President for Student Affairs

David G. Topel, Ph.D., Dean of the College of Agriculture

Benjamin J. Allen, Ph. D., Dean of the College of Business

Mark C. Engelbrecht, M. Arch., Dean of the College of Design

Walter H. Gmelch, Ph.D., Dean of the College of Education

James L. Melsa, Ph.D., Dean of the College of Engineering

Carol B. Meeks, Ph.D., Dean of the College of Family and Consumer Sciences

Dean of the College of Liberal Arts and Sciences

Richard F. Ross, Ph.D., Dean of the College of Veterinary Medicine

Patricia B. Swan, Ph.D., Vice Provost for Research and Advanced Studies and Dean of the Graduate College

Stanley R. Johnson, Ph.D., Vice Provost for Extension

Kathleen MacKay, Ph. D., Dean of Students

Olivia M. Madison, M.A., Dean of Library Services

Accreditation

Iowa State University is accredited by the Commission on Institutions of Higher Education of the North Central Association of Colleges and Schools.

North Central Association of Colleges and Schools
Commission on Institutions of Higher Education
30 N. LaSalle Street, Suite 2400
Chicago, IL 60602-2504
(800) 621-7400; (312) 263-0456;
Fax: (312) 263-7462
www.ncacihe.org

Admissions and Registrar

Emeritus Dean of Admissions and Records:
Fred C. Schlunz, M.S.

Office of Admissions

Director: Marc Harding, B.A.

Associate Directors: Phil Caffrey, M.S.;
Stephanie Wells, M.S.

Assistant Directors: Diane Bengtson, M.S.E.;
Vern E. Hawkins, M.S.; Patricia J. Parker, B.A.

Office of the Registrar

Registrar: Kathleen M. Jones, M.S.

Associate Registrar: Larry Dau, B.S.

Assistant Registrars: Laura J. Doering, B.A.,
Judy Minnick, B.L.S.

Systems Support Specialist: Clare Smith-
Larson, B.A.

Communications Coordinator: Charlene
Hulsebus, B.S.

Admission

When to Apply

Applicants for the fall semester are encouraged to apply during the fall of the year preceding their entry to Iowa State University. Applications for other terms should be submitted six to nine months in advance of the desired entry date.

Completed applications for admission to the professional curriculum in the College of Veterinary Medicine, together with the required supporting transcripts, must be received by an established deadline. See *The College of Veterinary Medicine, Application and Admission* on page 109.

How to Apply

Applications for admission may be obtained by writing the Office of Admissions, Alumni Hall, Iowa State University, Ames, Iowa 50011-2010; by calling 515-294-5836 or 800-262-3810; or by e-mail to admissions@iastate.edu. Applicants should describe their educational backgrounds and indicate the area in which they plan to study. An application form and detailed information concerning admission will then be sent by the Office of Admissions. Applications are also available on the Web at www.iastate.edu/~adm_info.

Applicants seeking admission for the fall semester may be notified of the action taken on their applications as early as the September preceding enrollment, upon receipt of all application materials. Applicants for other terms will be notified approximately two to three weeks after receipt of all materials. Admission offers are issued for a specific term and are valid only for the term specified.

Visits to the Campus

Visitors to Iowa State University are always welcome!

The Office of Admissions, located in Alumni Hall, is open Monday through Friday from 8 a.m. until 5 p.m., and most Saturday mornings from 9 a.m. until noon. Counselors are available to speak with prospective students and their families about admission, financial aid, housing, student life, and academic programs and opportunities.

Student-guided walking tours of the campus are offered weekdays at 10 a.m. and 2 p.m., and most Saturdays at 10 a.m. Prospective students and parents are encouraged to visit the campus and the Office of Admissions. Contact the Office of Admissions at 515-294-5836 or 800-262-3810 to arrange a campus visit or register for a special open house program called "Experience Iowa State."

Admissions policies are established by the Faculty Senate. Admission decisions are made by the admissions officers in accordance with these policies.

Undergraduate Admission into Degree Programs Directly from High School

Students who seek admission must meet the following requirements and also any special requirements for the college or curriculum of their choice.

Applicants must submit an application for admission, together with a \$20 application fee (\$50 for international students), and have their secondary school provide an official transcript of their academic record, including credits and grades, rank in class, and certification of graduation.

Applicants must also arrange to have their scores from either the ACT Assessment (ACT) or the Scholastic Assessment Test (SAT I) reported to Iowa State directly from the testing agency (ACT is preferred). The Test of English as a Foreign Language (TOEFL) is also required of applicants whose first language is not English, if their scores on the ACT or SAT are not adequate to place them into freshman composition courses at Iowa State.

Applicants may be required to submit additional information or data to support their applications.

a. Graduates of approved Iowa high schools who have the subject-matter background required by Iowa State University and who rank in the upper half of their graduating class will be admitted. Students who do not rank in the upper half of their graduating class may be admitted to the university if they achieve the following combination of high school rank and ACT or SAT I scores:

High School Rank (99% is high)	ACT Composite Score	SAT I Combined Score
49-47%	20	930
46-45%	21	970
44-42%	22	1010
41-39%	23	1050
38% or below	24	1090

Those who do not meet these requirements but who have a high school rank of 20% or above may be given the opportunity to enroll for a trial period during a preceding summer session to establish their qualifications for fall admission. Those who have a high school rank below 20% (and an ACT below 24) will be denied admission.

b. Nonresidents of Iowa, including international students, may be held to higher academic standards, but must meet at least the same requirements as resident applicants.

c. Applicants who are graduates of nonapproved high schools will be considered for admission in a manner similar to applicants from approved high schools, but additional emphasis will be given to scores earned on standardized examinations.

d. Applications may be considered from students who did not graduate with their high school classes. They will be required to submit all academic data to the extent that it exists and achieve scores on standardized examinations which will demonstrate that they are adequately prepared for academic study.

e. Students with superior academic records may be admitted, on an individual basis, for part-time university study while enrolled in high school or during the summers prior to high school graduation.

f. Exceptional students may be admitted as full-time students before completing high school. Early admission is provided to serve persons whose academic achievement and personal and intellectual maturity clearly suggest readiness for college-level study.

High School Preparation Required for Admission

Graduation from an approved high school shall ordinarily precede entrance into the university.

Students who wish to enter Iowa State University directly from high school (or transfer from another college or university with less than 24 semester hours of graded transferable college credit) must meet the level of academic performance described above and show evidence of the following high school preparation:

English/Language Arts

Four years, emphasizing writing, speaking, and reading, as well as an understanding and appreciation of literature;

Mathematics

Three years, including one year each of algebra, geometry, and advanced algebra;

Science

Three years, including one year each of courses from two of the following fields: biology, chemistry, and physics;

Social Studies

Two years.

Additional Entrance Requirements for the College of Liberal Arts and Sciences

In addition to the high school preparation requirements described above, students applying to the College of Liberal Arts and Sciences must have completed an additional year of social studies, for a total of three years, and two years of a single foreign language.

Students who do not meet the high school course preparation requirements listed here, but who are otherwise well qualified, may be admitted after individual review of their applications.

Undergraduate Admission into Degree Programs by Transfer from Other Educational Institutions

Students who seek admission must meet the following requirements and also any special requirements for the college or curriculum of their choice.

Applicants must submit an application form for admission, together with a \$20 application fee (\$50 for international students), and request that each college they have attended send an official transcript of record to the Office of Admissions. Failure to provide transcripts from all colleges or universities attended may result in denial of the application or dismissal from the university. If less than 24 semester hours of graded transferable college credit will be completed prior to entry at Iowa State University, applicants must also request that their official high school transcript and ACT or SAT I scores be sent to the Office of Admissions. Other transfer applicants are encouraged to provide high school academic information. Students who do not do so may be asked to take course placement examinations during orientation.

The Test of English as a Foreign Language (TOEFL) is required of students whose first language is not English.

a. Transfer applicants with a minimum of 24 semester hours of graded transferable credit from regionally accredited colleges or universities, who have achieved for all college work previously attempted the grade point average required by Iowa State for specific programs, will be admitted. A 2.00 grade point average (on a 4.00 grading scale) is the minimum transfer grade point average requirement. Some programs may require a transfer grade point average higher than this minimum. Higher academic standards may be required of students who are not residents of Iowa, including international students.

Applicants who have not maintained the grade point average required by Iowa State University for specific programs or who are under academic suspension from the last college attended generally will be denied admission.

b. In addition to meeting the minimum transfer grade point average requirement described above, applicants who have completed fewer than 24 semester hours of graded transferable college credit prior to their enrollment at Iowa State must also meet the admission requirements for students entering directly from high school.

c. Transfer applicants under disciplinary suspension will not be considered for admission until information concerning the reason for the suspension has been received from the college assigning the suspension. Applicants granted admission under these circumstances will be admitted on probation.

d. Transfer applicants from colleges and universities not regionally accredited will be considered for admission on an individual basis, taking into account all available academic information.

Transfer Credit Practices

Iowa State University endorses the *Joint Statement on Transfer and Award of Academic Credit* approved by the American Council on Education (ACE) and the American Association of Collegiate Registrars and Admissions Officers (AACRAO). The current issue of *Transfer Credit Practices of Designated Educational Institutions*, published by AACRAO is an example of a reference used in determining transfer credit.

The acceptance and use of transfer credit are subject to limitations in accordance with the educational policies of Iowa State University.

a. Students from regionally accredited colleges and universities.

Credit earned at regionally accredited colleges and universities is acceptable for transfer, except that credit in courses determined by Iowa State University to be of a developmental, vocational, or technical nature, or credit in courses or programs in which the institution

granting the credit is not directly involved, may not be accepted, or may be accepted to a limited extent.

No more than 65 semester or 97 quarter credits earned at two-year colleges can be applied to a bachelor's degree from Iowa State University. While there is no limit to the number of credits that may be transferred from a four-year institution, the last 32 semester credits must be completed at Iowa State.

b. Students from colleges and universities which have candidate status.

Credit earned at colleges and universities which have become candidates for accreditation by a regional association is acceptable for transfer in a manner similar to that from regionally accredited colleges and universities if the credit is applicable to the bachelor's degree at Iowa State University.

Credit earned at the junior and senior classification from an accredited two-year college which has received approval by a regional accrediting association for change to a four-year college may be accepted by Iowa State.

c. Students from colleges and universities not regionally accredited.

When students are admitted from colleges and universities not regionally accredited, they may validate portions or all of their transfer credit by satisfactory academic study at Iowa State, or by examination. The amount of transfer credit and the terms of the validation process will be specified at the time of admission.

In determining the acceptability of transfer credit from private colleges in Iowa which do not have regional accreditation, the Regent Committee on Educational Relations, upon request from such institutions, evaluates the nature and standards of the academic program, faculty, student records, library, and laboratories.

In determining the acceptability of transfer credit from colleges in states other than Iowa which are not regionally accredited, acceptance practices indicated in the current issue of *Transfer Credit Practices of Designated Educational Institutions* will be used as a guide. For institutions not listed in the publication, guidance is requested from the designated reporting institution of the appropriate state.

d. Students from foreign colleges and universities.

Transfer credit from foreign educational institutions may be granted after a determination of the type of institution involved, its recognition by the educational authorities of the foreign country, and an evaluation of the content, level, and comparability of the study to courses and programs at Iowa State. Credit may be granted in specific courses or assigned to general areas of study. Extensive use is made of professional journals and references which describe the educational systems and programs of individual countries.

Additional Transfer Credit Policies

a. Students with credit obtained during military service.

Credit will be awarded for successful completion of technical or specialized schools attended while on active duty with the armed forces to the extent that the material is applicable toward degree requirements at Iowa State University. Application for such credit is made at the Office of Admissions, which follows many of the recommendations in the American Council on Education (ACE) publication *A Guide to the Evaluation of Educational Experiences in the Armed Services*.

b. Students with credit obtained through non-college sponsored instruction.

Credit will be awarded for successful completion of learning acquired from participation in formal courses sponsored by associations, business, government, industry, and unions to the extent that the material is applicable toward degree requirements at Iowa State University. Application for such credit is made at the Office of Admissions, which follows many of the recommendations in the American Council on Education (ACE) publication *The National Guide to Educational Credit for Training Programs*.

c. Students with credit obtained through correspondence courses.

Although Iowa State does not offer correspondence courses, college-level courses taken by correspondence from accredited colleges or universities are acceptable for transfer at the undergraduate level if the courses taken are those that do not require laboratory study.

d. College Level Examination Program (CLEP).

Iowa State University will award credit for each of three CLEP general examinations (social sciences and history, humanities, and natural sciences) for test scores at or above the 60th percentile on national norms. Iowa State University will also award credit for each of nine subject examinations, for test scores at or above the 50th percentile on national norms. American government, introductory psychology, principles of accounting, general biology, calculus with elementary functions, introductory sociology, macroeconomics, microeconomics, and trigonometry.

Application of CLEP credit to a degree program varies with the department, so students should consult with their department before they register for CLEP examinations.

e. Students with "test-out" credit.

Students who have earned credit at other colleges or universities through Advanced Placement (AP), College Level Examination Program (CLEP), or International Baccalaureate (IB) examinations may qualify for credit at Iowa State University. Scores from these examinations should be sent directly to the Office of Admissions; credit will be awarded provided the scores satisfy Iowa State's requirements.

Credit earned at another college through locally designed test-out examinations may transfer to Iowa State University if accompanied by at least 12 transferable semester credits earned through coursework taken at that institution.

f. Articulation/Transfer Agreements.

1. Iowa Regent Universities General Education Articulation Agreement.

Iowa State University participates in an articulation agreement with the other two Iowa Regent universities concerning the acceptance of their general education programs into the Iowa State University College of Liberal Arts and Sciences. Under the terms of this agreement, students who have satisfied general education requirements at the University of Northern Iowa or in the College of Liberal Arts at the University of Iowa may transfer to Iowa State's College of Liberal Arts and Sciences with their general education requirements met (with the possible exception of the foreign language and library requirements).

2. Associate in Arts (A.A.) Articulation Agreement with Iowa public community colleges.

Students who plan to enter the College of Liberal Arts and Sciences at Iowa State University with an associate in arts degree from an Iowa public community college, and who have at least 60 prescribed semester (90 quarter) credits acceptable for transfer and at least a 2.00 cumulative grade point average, will be considered to have met the general education requirements of the college (with the possible exception of the foreign language and library requirements).

3. Vocational-technical credit from Iowa public community colleges.

Iowa State University will accept up to 16 semester (24 quarter) credits earned in vocational-technical courses where the sending Iowa public community college will accept such courses toward its associate in arts or associate in science degree. Certain vocational-technical courses at Iowa community colleges may be articulated to Iowa State University as academic credit. The hours earned in these articulated courses would transfer in addition to the 16 semester hour vocational-technical maximum. Please refer to the course equivalency guides on the Web (www.iastate.edu) or contact the Office of Admissions for more information.

4. AP and CLEP credit from Iowa public colleges and universities.

Iowa State University has an agreement with the Iowa public colleges and universities which allows credit earned through AP and CLEP examinations to transfer directly to Iowa State University if accompanied by at least 12 transferable semester credits earned through coursework taken at the sending institution.

Special Admission (Nondegree Undergraduate)

Students who wish to attend Iowa State University to take undergraduate courses but who do not plan to seek an undergraduate degree from Iowa State University should apply as nondegree students. Credit taken under the nondegree student classification is applicable for undergraduate degree purposes for those who are later admitted as degree-seeking undergraduate students. Credit obtained under the nondegree student classification may not, however, be applied toward a graduate degree.

Students enrolled in the Intensive English and Orientation Program (IEOP) are classified as nondegree students in the College of Liberal Arts and Sciences, and usually are not permitted to enroll in academic courses until they have satisfied requirements for admission as degree-seeking undergraduate students. Permission to enroll in one academic course in addition to full-time intensive English study may be granted under special circumstances.

Admission of Reentering Students

Reentering students are those who have previously attended Iowa State University and are returning after an absence of at least one full year. The reentry process for students who left Iowa State in good academic standing is described in the *Iowa State University Bulletin, Courses and Programs*. (International students need to reapply after an absence of one full semester, exclusive of summer session.) See *Index, "Reentry"* for more information.

Reentering graduate students do not need to complete a reentry form but should notify their department and the Office of the Registrar of their intent to reenter Iowa State University.

Students who are returning to Iowa State University to pursue an undergraduate degree after an extended absence may request permission to remove one or more of their complete academic terms from future degree and grade point average considerations.

Residency

Classification of Residents and Nonresidents for Admission, Tuition, and Fee Purposes

These criteria are contained in the *Iowa Administrative Code: Board of Regents*.

General

A. A person enrolling at one of the three state universities shall be classified as a resident or nonresident for admission, tuition, and fee purposes by the registrar or someone designated by the registrar. The decision shall be based upon information furnished by the student and other relevant information.

B. In determining resident or nonresident classification, the issue is essentially one of why the person is in the state of Iowa. If the person is in the state primarily for educational purposes, that person will be considered a nonresident. For example, it may be possible that an individual could qualify as a resident of Iowa for such purposes as voting, or holding an Iowa driver's license, and not meet the residency requirements as established by the Board of Regents for admission, tuition, and fee purposes.

C. The registrar, or designated person, is authorized to require written documents, affidavits, verifications, or other evidence deemed necessary to determine why a student is in Iowa. The burden of establishing that a student is in Iowa for other than educational purposes is upon the student. A student may be required to file any or all of the following:

1. A statement from the student describing employment and expected source of support
2. A statement from the student's employer
3. A statement from the student's parents verifying nonsupport and the fact that the student was not listed as a dependent on tax returns for the past year and will not be so listed in future years
4. Supporting statements from persons who might be familiar with the family situation
5. Iowa state income tax return.

D. Change of classification from nonresident to resident will not be made retroactive beyond the term in which application for resident classification is made.

E. A student who gives incorrect or misleading information to evade payment of nonresident fees shall be subject to serious disciplinary action and must also pay the nonresident fees for each term previously attended.

F. Review committee. These regulations shall be administered by the registrar or someone designated by the registrar. The decision of the registrar or designated person may be appealed to a university review committee. The finding of the review committee may be appealed to the State Board of Regents.

Guidelines

The following guidelines are used in determining the resident classification of a student for admission, tuition, and fee purposes:

A. A financially dependent student whose parents move from Iowa after the student is enrolled remains a resident provided the student maintains continuous enrollment. A financially dependent student whose parents move from Iowa during the senior year of high school will be considered a resident provided the student has not established domicile in another state.

B. In deciding why a person is in the state of Iowa, the person's domicile will be considered. A person who comes to Iowa from another state and enrolls in any institution of postsecondary education for a full program or substantially a full program shall be presumed to have come to Iowa primarily for educational reasons rather than to establish a domicile in Iowa.

C. A student who was a former resident of Iowa may continue to be considered a resident provided absence from the state was for a period of less than 12 months and provided domicile is re-established. If the absence from the state is for a period exceeding 12 months, a student may be considered a resident if evidence can be presented showing that the student has long-term ties to Iowa and re-establishes an Iowa domicile.

A person or the dependent of a person whose domicile is permanently established in Iowa, who has been classified as a resident for admission, tuition, and fee purposes, may continue to be classified as a resident so long as domicile is maintained, even though circumstances may require extended absence of the person from the state. It is required that a person who claims Iowa domicile while living in another state or country will provide proof of the continual domicile as evidence that the person:

1. Has not acquired domicile in another state;
2. Has maintained a continuous voting record in Iowa; and
3. Has filed regular Iowa resident income tax returns during absence from the state.

D. A student who moves to Iowa may be eligible for resident classification at the next registration following 12 consecutive months in the state provided the student is not enrolled as more than a half-time student (6 credits for an undergraduate or professional student, 5 credits for a graduate student) in any academic year term, is not enrolled for more than 4 credits in a summer term for any classification, and provides sufficient evidence of the establishment of an Iowa domicile.

E. A student who has been a continuous student and whose parents move to Iowa may become a resident at the beginning of the next term provided the student is dependent upon the parents for a majority of financial assistance.

F. A person who is moved into the state as the result of military or civil orders from the government for other than educational purposes, or the dependent of such a person, is entitled to resident status. However, if the arrival of the person under orders is subsequent to the beginning of the term in which the student is first enrolled, nonresident fees will be charged in all cases until the beginning of the next term in which the student is enrolled. Legislation, effective July 1, 1977, requires that military personnel who claim residency in Iowa (home of record) will be required to file Iowa resident income tax returns.

G. A person who has been certified as a refugee or granted asylum by the appropriate agency of the United States, who enrolls as a student at a university governed by the Iowa State Board of Regents, may be accorded immediate resident status for admission, tuition, and fee purposes where the person:

1. Comes directly to the state of Iowa from a refugee facility or port of debarkation, or
2. Comes to the state of Iowa within a reasonable time and has not established domicile in another state.

Any refugee or individual granted asylum not meeting these standards will be presumed to be a nonresident for admission, tuition, and fee purposes and thus subject to the usual method of proof of establishment of Iowa residency.

H. An alien who has immigrant status establishes Iowa residency in the same manner as a United States citizen.

Facts

A. The following circumstances, although not necessarily conclusive, have probative value in support of a claim for resident classification:

1. Reside in Iowa for 12 consecutive months, and be primarily engaged in activities other than those of a full-time student, immediately prior to the beginning of the term for which resident classification is sought.
2. Reliance upon Iowa resources for financial support.
3. Domicile in Iowa of persons legally responsible for the student.
4. Former domicile in the state and maintenance of significant connections therein while absent.
5. Acceptance of an offer of permanent employment in Iowa.
6. Other facts indicating the student's domicile will be considered by the universities in classifying the student.

B. The following circumstances, standing alone, do not constitute sufficient evidence of domicile to affect classification of a student as a resident under these regulations:

1. Voting or registration for voting.
2. Employment in any position normally filled by a student.
3. The lease of living quarters.
4. Admission to a licensed practicing profession in Iowa.
5. Automobile registration.
6. Public records; for example, birth and marriage records, Iowa driver's license.
7. Continuous presence in Iowa during periods when not enrolled in school.
8. Ownership of property in Iowa, or the payment of Iowa taxes.

Summer Orientation

The summer orientation program consists of one-and-a-half-day sessions scheduled in June. Each spring, new students and their parents or spouses are asked to select a convenient time from among a number of orientation sessions that are scheduled during June. In addition to preparing their class schedules for fall semester, new students with their parents or spouses participate in guided tours of the university, attend informational meetings about policies and procedures at the university, and meet formally and informally with faculty, staff, and other new students and their families. These meetings, held in a comfortable, informative atmosphere, lessen existing anxieties, assist each person in the development of a clearer understanding of the challenge of the university environment, and make it possible for new students—with support from their parents or spouses—to begin to make the academic and social decisions that are faced by all students at the university.

Cyclone Aides, Iowa State undergraduate students with widely varying backgrounds and interests, help acquaint new students and their families with the university.

Housing and meals are provided in campus residence halls at a nominal cost. Cyclone Aides live in the residence halls with the new students and are available at all times for informal discussion.

Registration

In order to register for classes students must first accept their offer of admission by the university. Registration and the payment of assessed fees are required of all who attend classes. Enrollment is not complete until fees are paid, including room and board fees for those living in residence halls.

Students who wish to initiate registration within the period between the fifth and tenth class days must obtain written permission from the instructors under whom they will be taking coursework and the approval of the dean of the college in which they will be registered. Registration for any semester will be closed after the tenth class day.

For summer session the fifth and tenth class days would be replaced by the third and fifth class days. Details on the registration process and registration policies and regulations are provided on pages 37-39 in the section titled *Registration*.

Credit by Examination (CBE)

It is Iowa State University policy to grant academic credit by examination in many of the undergraduate courses listed in the university bulletin. Credit is awarded primarily in the introductory level classes in mathematics, natural, physical, and social sciences, and the liberal arts. Students with superior high school backgrounds or those with college-level proficiency in certain subject areas are strongly encouraged to investigate and attempt testing in the CBE programs available.

Types of CBE Programs

Students may earn academic credit in any of four ways and have that credit recorded on their academic record when they enroll. Programs accepted at Iowa State include the Advanced Placement (AP) Program, the International Baccalaureate (IB) Examinations, departmental examinations, and the College Level Examination Program (CLEP).

Advanced Placement (AP) Program of the College Board

This program allows students, while still in high school, to take examinations for credit at the college level. Iowa State University awards credit or advanced placement through the Advanced Placement Program in art, biology, chemistry, computer science, economics, English, foreign languages, government and politics, history, mathematics, music, physics, psychology and statistics. High school counselors and teachers will assist with testing arrangements.

Generally, students scoring 3 or better on the exams will be considered for course credit based on departmental review of the exams. In some departments, only scores of 4 or better will be considered for credit.

Correspondence concerning the Advanced Placement Program should be addressed to the College Board Advanced Placement Examinations, P.O. Box 977-IS, Princeton, New Jersey 08541.

International Baccalaureate Examinations

The International Baccalaureate Program, offered at many high schools in the United States and abroad, allows students the opportunity to take examinations for credit at the college level. These examinations are offered at subsidiary and higher levels.

Iowa State University awards credit for higher level examinations in the following subject areas: art and design, biology, chemistry, computing studies, economics, English, foreign languages, geography, history, mathematics, music, philosophy, physics, psychology, and social anthropology. Iowa State University also awards credit for subsidiary-level examinations in the following subject areas: biology, geography, mathematics, philosophy, and physics. Students must receive a minimum score of 4 to qualify for academic credit in most subject areas. Some departments, however, require a minimum score of 5.

Correspondence concerning the International Baccalaureate Program should be addressed to International Baccalaureate, North America, 200 Madison Avenue, Suite 2403, New York, New York 10016-3903.

Departmental Examinations

Students may take locally constructed departmental examinations for undergraduate credit in specified subject areas for which they and the department feel they have the necessary

preparation. These exams are generally administered by the department which offers the course (for exceptions, see CLEP offerings below). Students interested in taking departmental (or CLEP) examinations should contact the appropriate department for specific information on the course covered by the exam and the exam itself. A nonrefundable fee is charged for each departmental examination requested. If an acceptable exam score is achieved, a grade of T will be reported to the Office of the Registrar. The T grade represents performance equivalent to a C or better in the course. T grades are not used in computing students' grade point averages; however, the credit does become part of their official academic record and may be applied toward their graduation requirements.

A list of the most frequently requested exams and the date(s) and time(s) they are administered each semester is published in each semester's *Schedule of Classes*. Most examinations for credit are prepared by the departments offering the courses. In some cases, the examination used is part of the College Level Examination Program (CLEP), where the content of the CLEP test has been judged to be an equivalent to the content of the course.

College Level Examination Program

Iowa State University will award up to six semester credit hours in each of three general CLEP tests (Social Sciences and History, Humanities, and Natural Sciences) if the test score places the student at or above the 60th percentile on national norms. Iowa State University does not accept the general CLEP tests in either mathematics or English. In addition, the College of Engineering does not allow credit earned from CLEP general tests to be used in their students' degree programs.

Subject CLEP tests accepted at Iowa State University include American Government (Pol S 215); Introductory Accounting (Acct 284 and 285; engineering majors should consult with their academic adviser before registering for this examination); General Biology (Biol 109, not for biology or engineering majors); Introductory Psychology (Psych 101); Introductory Sociology (Soc 134); Macroeconomics (Econ 102); Microeconomics (Econ 101); Trigonometry (Math 141); and Calculus with Elementary Functions (Math 165). Students must score at or above the 50th percentile on national norms to qualify for credit.

A nonrefundable fee is charged for each CLEP test requested and all requests must be made two weeks prior to the test date in order to guarantee that a test booklet is available. CLEP tests are administered by the Student Counseling Service on one Tuesday of every month. During the month of June they will be given on two Saturdays. For information on whether to take any of the CLEP tests, contact the department that offers the course. To obtain information on any of the CLEP tests, contact the Student Counseling Service, Testing Office, 373 Student Services Building, Iowa State University, Ames, Iowa 50011.

Policies and Procedures Governing CBE Tests

1. Departmental and CLEP tests are offered to newly admitted or currently enrolled students at Iowa State University. Former and future students will receive credit only if they enroll sometime during the twelve months immediately following the test(s).

2. Permission to take a departmental examination is obtained from the department. Students may be denied permission because (a) the nature of the course is such that proficiency cannot be measured by such a test, (b) the student does not appear to have adequate background to pass the examination for the course, or (c) the student would not otherwise be allowed to enroll in the course. Students may appeal such a denial to the dean of the college in which the department is administered and subsequently to the provost.

3. Students may ordinarily attempt a CBE test only once in any course or area. Under special circumstances a re-test may be taken upon approval of the department in which the course is offered.

4. Departmental examinations and CLEP subject tests cover only a single course and students may not test out of independent study or special topic courses.

5. There is a nonrefundable fee for all departmental and CLEP tests. The fee is set by the Board of Regents and is subject to change.

6. Examinations are usually given just prior to, or within two weeks of, the beginning of fall and spring semesters. For more information, students should check the Schedule of Classes, or contact the department that offers the class.

7. Credit for the CLEP general examinations is not evaluated as equivalent to any specific course and cannot be used in place of specific course requirements for the major. All colleges (except Engineering, which does not accept these tests) allow CLEP general credits to be used for either general requirements or elective credit. Students are responsible for checking with their academic advisers to determine whether such credit is to their benefit.

8. Listed below are policies for transferring CBE from another college or university to Iowa State University:

a. AP or CLEP credit which is earned at an Iowa public college or university may be transferred directly to Iowa State University provided it is accompanied by at least 12 semester credits earned in residence at the sending institution. AP or CLEP credit which is earned at any other college or university may not be transferred directly to Iowa State. However, the scores from these examinations may be sent to Iowa State University from the testing agency, and credit will be awarded based on Iowa State's AP and CLEP policies.

b. IB credit earned at another college or university may not be transferred directly to Iowa State University. However, the scores from IB examinations may be sent to Iowa State from the testing agency, and credit will be awarded based on Iowa State's IB policies.

c. Credit earned at another college or university through local test-out examinations may be transferred directly to Iowa State University provided it is accompanied by at least 12 semester credits earned in residence at the sending institution.

9. Credit earned from CBE will be posted to the student's academic record at the end of the term. However, CBE credits will be counted toward the projected year in school classification used to establish registration start dates.

10. Some professional programs do not accept T credit in preprofessional courses. Students who anticipate applying to such programs should inquire about the acceptability of such credit before registering for such CBE tests.

11. Credit established at Iowa State University will usually transfer to other colleges and universities; however, the final decision rests with the institution reviewing the transcript.



Office of Campus Visits, Orientation, and New Student Days

Director: Ardys Ulrichson, Ph.D.

Campus Visits Coordinator: Mary Carey, B.S.

New Student Days Coordinator:
Elizabeth Kurt, B.S.

Group Visits Coordinator: Ann Gogerty, B.A.

Orientation

The purpose of orientation is to help new undergraduate students make a smooth transition to Iowa State University. At orientation, students plan their academic programs, take tests to ensure placement in appropriate courses, register for classes, learn about university policies and procedures, and prepare for their personal and social adjustment to the university. The University Orientation Committee, composed of Iowa State University students, faculty, and staff, is responsible for the orientation programs; the undergraduate colleges of the university, in cooperation with the Office of Campus Visits and Orientation, have responsibility for the implementation of orientation programs for new students and their families.

The Orientation Committee conducts an extensive orientation program during the summer, with additional programs held prior to each term. Special orientation sessions are conducted for transfer students during the spring. Special orientation programs are also held for older-than-average students, international students, and graduate students. New students receive a written invitation to attend an orientation program before their first semester at the university. Parents or spouses are encouraged to accompany students.

New Student Days

New Student Days are held on the Thursday, Friday, and Saturday before classes begin fall semester. The program helps new students develop academic, computer, and social strategies to ensure a successful transition to Iowa State University.

WelcomeFest

WelcomeFest activities are scheduled during the first week of fall semester to welcome students to campus. All students, including transfer students, are invited to participate in WelcomeFest.

Extended and Continuing Education

Off-Campus Credit Courses and Programs

Iowa State University remains true to the land-grant tradition of extending knowledge far beyond campus borders. Annually thousands of students enroll in ISU courses without setting foot in Ames. In addition to the traditional method of Iowa State University instructors traveling to classrooms off campus, technology has provided new ways for Iowa State University faculty to reach out to students. Iowa State University offers distance education courses over the Iowa Communications Network (ICN), by videotape and on the World Wide Web.

Courses are the same as those offered on campus, carry residential credit, and are taught by ISU faculty members. Credit earned in off-campus courses becomes a part of your academic record at Iowa State University and may be used to meet degree requirements in the same manner as credit earned on campus.

ISU Extended Education personnel provide leadership and support to faculty in their efforts to identify the needs of Iowans and to reach and satisfy adult learners who wish to earn college credit without attending classes on campus.

For a list of currently available courses or to request specific courses and programs, contact Extended and Continuing Education in Ames 515-294-6222 or toll-free 800-262-0015, or:

ISU Outreach Center at Kirkwood in Cedar Rapids—319-398-1272
ISU Outreach Center at Indian Hills in Ottumwa—515-682-8324
ISU Outreach Center at Hawkeye in Waterloo—319-296-4025
ISU Outreach Center at DMACC in Ankeny—515-965-7314
ISU Outreach Center at NIACC in Mason City—515-424-5432
ISU Outreach Center at WITCC in Sioux City—712-274-0048
Southwest Area Outreach Center in Lewis—712-769-2600

Some off-campus credit courses are offered to serve the special interests or needs of a particular group. For information on how to schedule off-campus courses, call 800-262-0015. Often a series of courses are offered to fulfill certification or degree program objectives. Following are descriptions of the off-campus programs currently offered through Iowa State University:

College of Agriculture

The faculty of the College of Agriculture offer a bachelor of science degree in professional agriculture and a master of agriculture for off-campus students. Courses are delivered via videotape, interactive television, computer, and face-to-face instruction. For more information about the professional agriculture degrees, call toll-free 800-747-4478 or 515-294-1862.

Master of Agriculture

The master's program is ideal for farmers and agribusiness people with bachelor's degrees, who want to upgrade their professional education. You take core courses and complement them with a program of individual interest. Core courses are offered in the following disciplines: agricultural economics, agriculture education and studies, agricultural systems technology, agronomy, animal science, and horticulture. You take a minimum of two courses in each of three disciplines and complete 24 semester credits of formal course work. A minimum of four credits of creative component experience is required. The creative component is a demonstration of independent creativity with a written report of laboratory, field, or library research.

The program is 32 credits; additional credits are in workshop courses, including one in statistics.

Professional Agriculture Bachelor of Science

Designed for students who have completed or are in the process of completing foundation college courses, the Professional Agriculture bachelor program provides a high-quality, flexible curriculum for you to increase and update your agricultural knowledge. A diverse group of students is active in the program, including those who left college years ago without a degree to those who need new knowledge to use on-the-job or for career enhancement. The course of study encompasses three major areas: animal science, agricultural social sciences and economics, and plant and soil sciences. The agricultural course work, a minimum of 45 credits, is a well-rounded mix of agricultural topics. You may take a portion of the course work from colleges in close proximity to your home and transfer the credits to Iowa State University.

College of Education

The College of Education endeavors to identify needs of educators across the state and provide suitable courses and programs to satisfy those needs.

The Community College Induction/Mentoring (CCIM) Program

The Community College Induction/Mentoring (CCIM) program is a two-year sequence of 14 seminars for community college and secondary occupational instructors who have years of professional experience but no previous teacher education preparation.

CCIM uses a support network pairing new teachers with experienced teachers. Mentors regularly visit your classroom, demonstrate lesson plans and serve as a local resource for assignments given during monthly CCIM seminars. Specific teaching skills learned in CCIM are applied immediately in your classrooms.

Seminar dates are set two years in advance. Each year, 25 new teachers are accepted into the program. Registrations for fall semester entry are accepted through July 15. The classes are concentrated into three or four Friday evening-Saturday all-day sessions each semester. The courses may be applied to State of Iowa community college vocational-technical and 7-12 grades provisional occupational endorsements

Courses are offered at a site selected by the students enrolled in the program.

For more information about CCIM, call toll-free 800-262-0015 or 515-294-4750.

Master of Education in Educational Leadership

A master's program of 40 credits called PREparation for LEADership, or PreLEAD, leads to licensing as a school administrator. Courses are structured to build leadership skills in organizational processes, scope and framework of schools, and interpersonal dimensions. The PreLEAD program sequence is five semesters and two summers long. The program includes a field experience of fifty-days to be completed in a mentor principal's school over the course of several terms. The master's program is delivered to selected Area Education Associations; each fall, new cohort groups begin.

For more information about PreLEAD, call toll-free 800-262-0015 or 515-294-5785.

Superintendency Certification Program (Certificate of Advanced Studies)

The certification program is designed for professional educators working as school principals and assistant principals, directors of curriculum and/or instruction, administrative assistants and board members. The program consists of 30 credit hours beyond the master's degree. Of these, 21 credits are in key required courses that ensure sound organizational leadership in public and private schools.

Key subject matter includes: administrative problems, curriculum, law, personnel administration, strategic and operational planning, business management, finance, leadership, public relations, and supervision of instruction. Courses are offered Friday evenings and Saturdays over the Iowa Communications Network (ICN).

Iowa superintendent certification requires completion of 30 units beyond the master's degree and a minimum of three years experience as a certified licensed school administrator.

For more information about the superintendent certification program, call toll-free 800-262-0015 or 515-294-5450.

College of Engineering

As one of the first universities in the nation to offer videotaped credit courses for practicing engineers, Iowa State University has 26 years of experience working with off-campus students. Today the engineering college offers four off-campus degree programs. Courses are delivered via videotape, the Iowa Communications Network, and through the National Technological University (NTU), a consortium of 47 universities that delivers about 200 credit courses each semester via satellite to engineers in participating industries across the country.

For more information about Iowa State's off-campus program in engineering, call toll-free 800-854-1675 or 515-294-7470.

Master of Engineering in Systems Engineering

A professional degree, the Master of Engineering in Systems Engineering, is designed to enable engineers, regardless of undergraduate discipline, to develop the analytical abilities needed to design, evaluate and build complex systems involving many components and demanding specifications. The program supports work across disciplinary boundaries and provides opportunities to develop management capabilities needed in today's work environment.

The College of Engineering developed the broad-based Master of Engineering in Systems Engineering degree program at the request of and with the guidance of major Iowa industry leaders. The degree is designed to provide a professional degree for engineers employed in a wide variety of industries.

The degree is 30 semester credit hours, including a three-credit creative component, individual study on a topic with significant systems engineering content. The project may be work related if it extends beyond on-the-job assignments.

Courses are delivered primarily by videotape to educational coordinators at participating industries. You view the tapes, carry out all assignments and projects, and take the examinations to earn academic credit.

Master of Science in Computer Engineering and Master of Science in Electrical Engineering

The College of Engineering at Iowa State University, in cooperation with the University of Iowa and local industries, offers two off-campus Master of Science programs. Each program totals 30 graduate credits; a thesis or non-thesis option may be selected. The thesis option is recommended for those who intend to continue toward the doctor of philosophy degree or a career in research and development. The nonthesis Master of Science degree requires a creative component.

Courses are delivered primarily by videotape to educational coordinators at participating industries. You view the tapes, carry out all assignments and projects, and take the examinations to earn academic credit. Credits are applicable to the requirements approved for a master's degree if included in the your individual program of study.

Bachelor of Science in Electrical Engineering

The Departments of Electrical and Computer Engineering and Mathematics deliver engineering and advanced mathematics classes in the electrical engineering program to Kirkwood Community College in Cedar Rapids. You may transfer up to 65 hours of basic work to Iowa State from Kirkwood, or from another community college. In some cases, credit from four-year colleges or other universities may also be transferred. With complete background preparation, including the social sciences and humanities courses, you should be able to finish five courses per year, and complete the degree program in four calendar years. The bachelor's degree requires a total of 126.5 semester credits. Courses are offered via the Iowa Communications Network.

College of Family and Consumer Sciences

The non-thesis degree program Master of Family and Consumer Sciences delivered off campus is designed for working professionals who need further education to understand and use new research findings. The comprehensive degree requires a minimum of 18-21 credits in two or more of the College of Family and Consumer Sciences departments: family and consumer sciences education and studies; food science and human nutrition; hotel, restaurant, and institution management; human development and family studies; and textiles and clothing.

At least six credits must be earned in each of the selected departments. In addition, credits are required in research methods and statistics. With electives, the degree program totals 36 credits. Courses are offered on the Iowa Communications Network (ICN).

For more information about the master's program in family and consumer sciences, call toll-free 800-262-0015 or 515-294-0211.

College of Liberal Arts and Sciences

Master of School Mathematics (MSM)

The Master of School Mathematics (MSM) program is designed for current secondary mathematics teachers. The degree program is built on three themes: enhancement of your knowledge of geometry, calculus, and discrete mathematics; importance of problem solving in learning and teaching mathematics; and use of computing technology in learning and teaching mathematics.

The course work includes geometry, topics in discrete optimization, intermediate calculus, a seminar on current literature in mathematics education, a statistics course, electives, and a creative component, totaling 36 semester credits.

The creative component may be taken during a summer, with most of the actual research and writing done during the preceding year.

Courses are offered over the Iowa Communications Network (ICN).

For more information about the master of school mathematics, call toll-free 800-262-0015 or 515-294-8147.

Certificate of Public Management

A 15-credit graduate study program offered by the public administration program and the Department of Political Science leads to the Certificate of Public Management. Usually, at least nine credits are taken from the core and methods courses. The remaining six credits are selected from a list of electives. This program is designed for active public administrators who wish to pursue a quality program within a reasonable time frame.

To enter the certificate program, you must be accepted into the Master of Public Administration (MPA) degree program. All courses taken towards the certificate may be applied to the MPA without further admissions requirements.

Courses are offered statewide via the Iowa Communications Network.

For more information about the certificate of public management, call toll-free 800-262-0015 or 515-294-0586.

Master of Science in Microbiology

The Department of Microbiology offers the non-thesis master program in microbiology. The program is designed primarily for working professionals who do not intend to continue work towards a doctor of philosophy. The program is 36 credits, not including research, and includes 5 credits of creative component. At least 30 credits must be in didactic courses. The courses are delivered by videotape and over the World Wide Web.

For more information about the master of science in microbiology, call toll-free 800-262-0015 or 515-294-2070.

Bachelor of Liberal Studies (BLS)

The bachelor of liberal studies is a general studies degree in the liberal arts, designed for those who have completed at least two years of college and wish to finish an undergraduate degree. Rather than a traditional major, you select course work from three of the following five distribution areas: humanities, communications and arts, natural sciences and mathematical disciplines, social sciences, and professional fields.

The BLS degree is offered with similar requirements by all three regent universities, and provides a framework to assemble all the educational opportunities you may have locally available into a coherent four-year educational program. Admission to the BLS program is granted after you complete an associate in arts or associate in science degree from an accredited two-year college or complete at least 62 semester credits acceptable toward graduation at ISU with a grade-point average of at least 2.00.

For more information about the BLS degree, call toll-free 800-262-0015 or 515-294-4831.

Admission

If you plan to work toward a degree, contact the coordinator of adult student admissions, 515-294-5836 or toll-free 800-262-3810.

You may take ISU courses without being formally admitted to a degree program, provided you meet the specific course prerequisites. You will be enrolled as a "nondegree and degree undergraduate" student, or as a "graduate nondegree" student. Transcripts are not required; list degree or high school graduation on the registration form. Current and former ISU on-campus students must be in good academic standing to enroll.

Nondegree Undergraduate Students. Credit taken under the nondegree student classification is applicable for undergraduate degree purposes for those who are later admitted as degree seeking undergraduate students. Credit obtained under the nondegree student classification may not, however, be applied toward a graduate degree. (See *Special Admission, Nondegree Undergraduate Students on page 10*.)

Graduate Students. If you hold a bachelor's degree from a regionally accredited college or university and take graduate courses, you must register as a graduate student. You may apply up to nine semester hours of graduate credit under the nondegree/undeclared option toward a graduate degree. Confer with your department to determine if work taken in non-degree status can be used in your graduate degree program.

Transfer from nondegree status to full graduate admission requires the completion of procedures specified by the Graduate College. (See *Graduate College Admissions*.)

Tuition. Tuition is set by the Iowa Board of Regents for both on-campus and off-campus credit courses. Some courses may have additional fees.

Services

Academic Advising. Individuals may obtain advice about educational plans, whether registered as an ISU student or not. Academic advising is essential when contemplating an ISU degree to ensure that all course work applies toward a particular degree's requirements. To talk with an adviser from a particular department or discipline, call Extended and Continuing Education.

Activity Fee. Off-campus students may pay a semester activity fee which qualifies them and their spouses for student admission rates to concerts, lectures, and athletic events. Students wanting to pay the activity fee should check the activity fee line on their registration form.

Library. A permanent *ISUCard* is issued to all students. The identification number is needed to check materials out of the ISU or DMACC, Ankeny libraries; to access by modem the ISU library's electronic card catalog, SCHOLAR; and to access Vincent, the ISU computer system. You may use materials in the library without an *ISUCard*. However, to take library materials out of the building or out of the reserve room, an *ISUCard* is needed.



Textbooks. Books for Iowa State University courses taught on the DMACC Ankeny campus can be purchased on the Ankeny campus in the Student Services Building, Building 5. Books are supplied by Iowa State University Book Store for other off-campus courses. To order books, call 800-325-3252. You may also order books on-line at <http://direct.mbsbooks.com/ia.htm>. Using the 800 number listed above or the on-line ordering address gives you access to used books and book-buyback by mail.

Continuing Education Units

Continuing Education Units (CEUs) may be awarded for short courses, workshops, and other educational activities sponsored by Iowa State University which do not carry academic credit. A given activity may award CEUs to some participants and academic credit to others, under the following policies:

1. The activity must be administered through Iowa State University Extended and Continuing Education.
2. The dual arrangement must have received prior approval by the department head or chair, upon recommendation of the course instructor and the department curriculum committee.
3. Participants may enroll for either CEUs or for credit, but not for both.
4. Credit enrollees must meet the same academic standards they would have to meet if the course did not also award CEUs to some participants.
5. Assignments for credit enrollees must be clearly articulated. Substantial sequential learning experiences and careful evaluation of outcomes are required for academic course credit; these standards will not be reduced to accommodate the participation of CEU learners. Whenever graduate credit is offered, course prerequisites will be enforced and not routinely waived.

Once CEUs have been awarded, no participant may change his or her enrollment to academic credit. Standard university policies for determining fees will be applied to all participants, depending on the status of their enrollment.

Participants must be informed ahead of time that once CEUs have been awarded to them, Iowa State cannot and will not convert them to academic credit. Further, a student can switch from CEU to credit during an offering only at the discretion of the course instructor.

Fees and Expenses

All fees, tuition, and expenses listed in this publication are effective as of summer session 1999. They are subject to change without notice.

A registration fee is charged to all students of the university. A full registration fee covers most laboratory fees, use of the library, membership in the Memorial Union, and a number of student activities. In certain courses involving special expenses, an additional fee may be charged. These fees are indicated in the course description of the specific courses involved.

Students who are not residents of Iowa pay an additional tuition fee each semester. This tuition fee is assessed in accordance with regulations of the State Board of Regents which are found in this bulletin under *Admissions and Registrar*.

Payment of Fees

Students are billed by the Accounts Receivable Office for tuition, room and board, and various other university charges. A statement of charges will be mailed on the first of each month to students at their in-session or interim address. It is the student's responsibility to ensure the Office of the Registrar has a correct mailing address. Students who do not receive a billing statement before the term begins should go to the Receivables Office to learn the amount of their account balance due. *Failure to receive a billing statement will not exempt students from late penalties or from having a hold placed on their registration.*

If payment of the minimum due is not made by the deadline printed on the billing statement, all fees become due immediately. A one-percent finance charge will be assessed on the total amount due at that time, and a "hold" will be placed on the student's registration until payment of the total amount due has been made.

If a student's registration has been canceled for nonpayment of fees, he or she may be reinstated with written permission from their college.

Deferred Payment

Most university fees are payable in three installments for fall and spring semesters. Payments for fall semester will be due September 15, October 15, and November 15. Deferred billing is not an option for the summer term. All fees are due in full on June 15. Payments for spring semester will be due February 15, March 15, and April 15. Students will be charged a \$15 administrative fee if they elect to use the deferred option. Students who do not pay their first payment in full by the due date will automatically select the deferred option.

Twelve-Month Payment Plan

Under the Twelve-Month Payment Plan, students pay the academic costs for fall and spring semesters in 12 installments beginning May 15 and ending the following April 15. A \$40 enrollment fee is due with the first monthly payment. All payments are deducted from the student's designated bank account. For more information about the Twelve-Month Payment Plan, contact the Receivables Office.

Past Due Accounts

Students with past due accounts receivable charges prior to the beginning of classes will be dropped from enrollment if these past due accounts are not paid before the first day of classes.

Registration Fee Schedule

	Resident	Nonresident
Per Semester		
Undergraduate (12 or more credits)	\$1393	\$4673
Graduate (9 or more credits)	1654	4872
Graduate M.B.A. (9 or more credits)	2158	5376
Veterinary Medicine (12 or more credits)	3178	8664

Fees for students enrolled for less than a full course load are given below in the Fee Schedule Per Credit. There is a minimum 2-credit fee for all students. Audits and zero credit courses are assessed on contact hours and there is a maximum charge for zero credit courses of 3 credit hours. R credits are assessed for the minimum fee only if no other credits are taken. The continuous registration fee for graduate students is \$70. If the total number of credits includes .5 credit, such as 6.5, fees are assessed on the next larger whole number of credits. Therefore 6.5 credit hours would be assessed as 7 credit hours.

Summer session fees are charged per credit as indicated in the fee schedule.

Private Music Instruction

University students, per semester	
1 credit	\$ 90
2 credits	130

Nondegree Students and Noncollegiate Students

Special students and noncollegiate students pay the same fees as undergraduates.

Effective Summer 1999, Fall 1999 & Spring 2000 Fee Schedule Per Credit

No. of Credits	Under-graduate		Graduate		Vet. Med.		Saturday MBA	
	Res.	Nonres.	Res.	Nonres.	Res.	Nonres.	Res.	Nonres.
1	\$234	\$234*	\$368	\$368*	\$530	\$530*	\$480	\$480*
2	234	234*	368	368*	530	530*	480	480*
3	351	351*	552	552*	795	795*	720	720*
4	468	468*	736	736*	1,060	1,060*	960	960*
5	585	1,950	920	2,710	1,325	3,610	1,200	2,990
6	702	2,340	1,104	3,252	1,590	4,332	1,440	3,588
7	819	2,730	1,288	3,794	1,855	5,054	1,680	4,186
8	936	3,120	1,472	4,336	2,120	5,776	1,920	4,784
9	1,053	3,510	1,654	4,872	2,385	6,498	2,158	5,376
10	1,170	3,900			2,650	7,220		
11	1,287	4,290			2,915	7,942		
12 or more	1,393	4,673			3,178	8,664		

*Nonresident students taking 4 credits or fewer are assessed at the resident rate.

Fees

Following are the descriptions of several commonly assessed fees for Iowa State University students. The list is not inclusive.

Activity: The activity fee for undergraduates and graduate students taking courses on campus is included in the general registration fee. Fees for courses taken off campus do not include the activity fee. Off-campus students may pay \$55 per semester which allows them to pay student admission rates to concerts, lectures, debates, and athletic events.

Application: A fee of \$20 must accompany the application for admission and is nonrefundable. The application fee for international students is \$50. This fee does not apply to special students or workshop applicants.

Change of Schedule: Starting the sixth day of classes a \$5 fee is charged for course drops, additions, and section changes. One fee is assessed for multiple changes processed at the same time for the same term.

Computer: All students are charged a computer fee each semester. Undergraduate and graduate students enrolled in the College of Engineering (including Biomedical Engineering and Systems Engineering) are charged \$169 per semester. Undergraduates and graduates in the Department of Computer Sciences or undergraduates in the major of Management Information Systems are charged \$133 per semester. All other students are charged the standard computer fee of \$51 per semester. Students enrolled less than full-time are assessed prorated computer fees according to the number of credits for which they are enrolled.

Graduate students holding research or teaching assistant appointments are charged \$84.50 for those in engineering; \$66.50 for those in computer science, and \$25.50 for all other

majors, regardless of the number of credits and regardless of the fraction of time they are on appointment.

Students enrolled only in courses of the following types are not assessed a computer fee: workshops, Co-op programs or internships; extended education enrollment courses, Foreign student programs, the Intensive English and Orientation Program, incoming students on exchange programs (except ISEP students who will be assessed), Regents exchange programs, Iowa Lakeside Laboratory courses, summer camps, agricultural travel program, practicum or student teaching experiences, Graduate Studies 600, 601 or 680, or as "required registration" status for graduation. High school students enrolled under the Post-Secondary Enrollment Options Act are not assessed a computer fee.

For students who withdraw, the adjustment schedule for tuition will also be used for computer fees. The credit adjustment schedule for reduction from a full load to light classification is 100 percent through the third week, with no refunds after the third week.

Students who change their major will be charged the full computer fee for the major into which they transfer if the change occurs before the end of the third week. If the change occurs after the third week, then no change in the computer fee assessment will occur.

Developmental Mathematics: Students enrolled in Math 10 or Math 20 will be charged \$234. This is a separate fee which is charged in addition to other fees and tuition. Students will be charged the developmental math fee each term they are enrolled in Math 10 or Math 20.

Extended and Continuing Education:

Undergraduate students pay \$117 per credit with a maximum charge of \$1,393; graduate students pay \$184 per credit, with a maximum

of \$1,654, and students enrolled in MBA, MPA, MEdEl courses pay \$240 per credit with a maximum of \$2,158.

Graduation Fee: Undergraduate and graduate students are charged a \$15 graduation fee the term they receive their degree.

Health Facility: All students are charged an \$8 Health Facility Fee each semester except for undergraduate students in co-op programs, students in off-campus courses only, incoming students on exchange programs (except ISEP students who will be assessed), graduate students enrolled in Graduate Studies 600, 601 or 680, Psych 597 or 697, students enrolled in workshops only and high school students enrolled under the Post-Secondary Enrollment Options Act. For students who withdraw or change to an exempt status as defined above, the refund schedule for tuition will be used for the health facility fee. These exceptions do not apply to international students (except where noted) or graduate students on "C" Base.

Late Fee Payment: If payment of the minimum due is not made by the deadline printed on the billing statement, all fees become due immediately. A one-percent finance charge will be assessed on the total amount due at that time. These students will also have a hold placed on their registration until payment of the total amount due has been made.

Late Registration: Students who do not complete their registration before the first day of classes are charged a late registration fee of \$20. Graduate students who do not complete their registration before the first day of classes are charged a late registration fee of \$20 the first week of classes, \$50 the second week of classes, and \$100 the third week of classes or later.

Matriculation: A fee of \$45 is charged for all new degree-seeking students prior to being admitted. This fee is charged to all new students except nondegree seeking students, veterinary medicine students, graduate students, and students enrolled in only off campus courses.

Senior: A \$2 fee covers the cost of special senior activities. This fee is optional.

Sponsored International Student: Agencies and foreign governments which require special administrative and fiscal reporting services of ISU will be assessed an administration fee. The fee for 1999-2001 will be 3 percent of the total tuition charge billed the sponsor. In succeeding years, the fee may be raised after 90 days advance notice to the sponsoring agency.



Student Health: A \$50 student health fee, which partially finances the services of the Student Health Center, is charged to all students each semester. This fee is not assessed to students enrolled for four credits or less; undergraduate co-op students; students enrolled in Extended Education courses only; students enrolled in workshops only; incoming students on exchange programs (except ISEP students who will be assessed); graduate students enrolled in Saturday MBA courses only; graduate students enrolled in Graduate Studies 600, 601, or 680, Psych 597 or 697; graduate students enrolled as continuous registration; and high school students enrolled under the Post-Secondary Enrollment Options Act.

(These exemptions do not apply to international students or to graduate students on C-base.) Students who are exempt from the health fee may participate in the Health Plus Plan as described under *Optional Fees*.

Students who withdraw or change to an exempt status as defined above will receive a credit adjustment of 100 percent during the first three weeks, with no credit adjustment after the third week. Students who add courses at any time during the semester will be assessed the student health fee if applicable according to the guidelines stated above.

Summer Camp: A special tuition rate is assessed to students participating in summer camp programs. The undergraduate assessment is \$468 and the graduate rate is \$736. Summer camp programs entitled to the special rate are Anthropology, Forestry, and Geology. Students will be charged other fees in addition to tuition for enrolling in these programs. To obtain total fee information, students should contact the director of the individual program.

Transcript: Students may obtain an official transcript of their student academic record for \$5. An additional \$2 service charge for each transcript is assessed if same day service is requested.

Workshops: Undergraduate students enrolled in 1, 2, or 3 credit workshops pay \$117 per credit hour tuition; graduate students pay \$184 per credit hour tuition.

Other Fees

Additional copies of Bulletin	\$3
Diploma Replacement	\$15
Duplicate Registration Materials	\$2
Identification Card Replacement	\$15
Returned Check Charge	\$20
Thesis	
Masters	\$45
Ph.D.	\$90

Refunds

Withdrawal Registration and Refund Schedule: To cancel their registration students must notify the Office of the Registrar before the first day of classes to avoid tuition assessment. Beginning the first day of classes, it will be necessary for students to formally withdraw from the university to terminate their registration. Tuition adjustments for continuously enrolled and returning students are made for withdrawals of registration according to the following schedule:

	Student Pays
Before first day of classes	0%
During class days 1-8	10%
During class days 9-20	50%
During class days 21-40	75%
After the fortieth day of classes	100%

Tuition adjustments for first time enrolled students are made for withdrawals according to the following schedule:

	Student Pays
Before first day of classes	0%
During class days 1-5	10%
During class days 6-15	20%
During class days 16-20	30%
During class days 21-30	40%
During class days 31-40	50%
During class days 41-45	60%
During class days 46-50	70%
After the fiftieth day of classes	100%

Fee refund for students who drop into light classification (less than full-time):

100 percent if change is made during first three weeks.

No adjustment is made after the third week.

Appropriate adjustments in the refund schedule are made when partial term courses are involved.

Students who wish to appeal tuition adjustments should contact the fees section of the Office of the Registrar. Decisions of the Office of the Registrar will be based on the existence of extenuating circumstances beyond the control of the student. Students who wish to appeal the decision of the Office of the Registrar must do so in writing within 10 calendar days after receiving the decision. Such appeals will then be reviewed by the Tuition Appeals Review Committee. Students who wish to appeal the decision of the Tuition Appeals Review Committee may make a request to do so in writing to the Office of the Provost.

For the refund policy for off-campus courses, contact ISU Extended and Continuing Education.

Workshop Refunds: Students who drop workshops or short courses of one or two weeks on or before the first class meeting receive a 100% tuition adjustment for the course. No tuition adjustment will be made after the first day of classes. Students who drop three-week courses receive a 100% adjustment if they drop on or before the first day of classes, a 90% adjustment if they drop on the second day of classes and no adjustment after the second day of classes.

Student Financial Aid

Director: Earl E. Dowling

Assistant Director: Deborah Burdick

Assistant Director: DeLores Hawkins

Assistant Director: Roberta Johnson

Assistant Director: Richard Lephart

Assistant Director: Charles Turner

Program Assistant: Brenda Voss

Advisers: Clay Gurganus, John Lueth, Ted Maakestad, Ann Wessman

The Office of Student Financial Aid staff helps families afford Iowa State University. Grants, scholarships, loans, and part-time employment opportunities are available in various combinations to pay the difference between the amount the student and his or her parents can reasonably be expected to provide and the cost of attending Iowa State University.

All state and federal aid programs are subject to review by their respective governing agencies and may be changed without notice.

Eligibility for many forms of financial aid is determined by the Free Application for Federal Student Aid (FAFSA). These applications are available from high schools or from the Office of Student Financial Aid by November of each year. Students should submit the FAFSA by mid-February prior to the fall term of enrollment, in order to receive priority consideration. A new application must be completed each academic year. **Applications must be received no later than March 1.** Applications received after March 1 will be awarded as funds are available. New students enrolling spring semester or summer session should complete the current year's aid application to apply for any available financial aid. To be eligible for financial aid, a student must be a U.S. citizen or permanent resident, enrolled on at least a half-time basis, and making satisfactory academic progress toward a degree. If signed copies of the student's and parents' income tax returns are requested, they should be sent directly to the Office of Student Financial Aid, 12 Beardshear Hall.

Students may use their financial aid for study in other countries if they have clearance for the transfer of credit to their degree programs and have made financial aid arrangements prior to departure. For further information, contact the Office of International Students and Scholars, 4 Hamilton Hall, or the Office of Student Financial Aid, 12 Beardshear Hall.

Financial aid programs generally consist of three types: gift aid (scholarships and grants), loans, and part-time employment. Laws, regulations, and policies governing these programs are subject to change.

I. Gift Aid

A. Scholarships

1. **ISU Scholarship/Grants.** These awards are based on financial aid eligibility as determined by the FAFSA. A student must complete the FAFSA to be considered. Many of these awards are based on academic or special talent in addition to financial eligibility.

2. **Entering freshmen** can obtain information by accessing the web site www.public.iastate.edu/~fin_aid_info/scholarships.html.

3. **College and Departmental Scholarships.** Students are encouraged to contact the scholarship chair in their department or college. Scholarships based on academic achievement and/or financial need are available in most areas of study, but students may need to complete separate applications to be considered.

4. Military Officer Education (ROTC) Scholarships:

Army. The Military Science Department offers 4-, 3-, and 2-year Army ROTC scholarships to qualified students on a competitive basis in virtually any academic discipline. These scholarships provide payment of tuition, all required fees (except student health), books and supplies allowance, and a monthly cash subsistence allowance. For applications or additional information, contact the Military Science Department at 132 Armory or call 515-294-1852.

Navy. The Naval Science Department offers several scholarship programs to qualified students. The scholarships cover payment of tuition, fees, books, and \$100 a month. Information is available from the Naval Science Department, 3 Armory, or by calling 515-294-6050 or 515-294-0328.

Air Force. The Air Force Aerospace Studies Department offers Air Force ROTC scholarships covering two or three years of college to qualified students. The scholarships provide payment of tuition, book fees, laboratory fees, and \$100 a month. Scholarships are available to students qualified in certain technical academic majors. Details on scholarship qualification, application procedures, and eligibility are available from the Department of Air Force Aerospace Studies, 515-294-1716.

5. **Other Scholarship Sources:** Students are encouraged to pursue funds from agencies and private organizations on campus and in their hometowns. An excellent resource, FASTWeb, may be found on the Internet. (See item #2 above for the address.)

B. Grants

1. **Federal Pell Grant.** The maximum annual award under this program is \$3,125. All undergraduate applicants for financial aid must apply for the Federal Pell Grant by completing the FAFSA. These forms are available from high

school counselors and the Office of Student Financial Aid.

2. **Federal Supplemental Educational Opportunity Grant.** An eligible undergraduate student may be awarded a grant of \$100 to \$4,000 on the basis of financial need. A student must complete the FAFSA in order to be considered.

3. **Iowa Grant.** Iowa residents demonstrating financial need may be eligible for a \$1,000 Iowa Grant. Students must complete the FAFSA to be considered.

4. **Iowa Minority Academic Grant for Economic Success (IMAGES).** Iowa minority students may qualify for this state-supported grant. Eligibility is based on demonstrated financial need, as determined by the FAFSA. Priority will be given to students who file their FAFSA by February 15 or who have participated in a College Bound activity. The maximum grant is \$2,500.

5. **Officer Education (ROTC) Financial Assistance Grants.** All students enrolled in Advanced ROTC (third and fourth years) in the Army, Navy, and Air Force programs are provided an allowance of \$100 per month for up to 10 months per year. The Navy program also includes a 4-year program which provides \$100 per month for up to 10 months per year. For further information, contact the appropriate ROTC department in 132 Armory.

6. **Tuition Assistance Grant for Undergraduate Foreign Students.** Undergraduate foreign students who are faced with financial hardship resulting from unforeseen circumstances may apply for this grant. The maximum award is \$700 per academic year. Apply to the Office of International Students and Scholars, 4 Hamilton Hall.

7. **International Student Financial Aid.** International students may contribute a small voluntary fee to this fund. These monies will be used to assist international students who have unforeseen financial emergencies. For further information, contact the Office of International Students and Scholars, 4 Hamilton Hall.

II. Loans

A. **Federal Perkins Loan.** An eligible undergraduate student may borrow up to \$4,000 per year, depending on financial need and the availability of funds. A maximum of \$15,000 for total undergraduate study is allowed. A maximum total of \$40,000 may be borrowed for undergraduate and graduate programs combined. Interest of 5 percent on the unpaid balance begins with repayment of the loan principal 9 months after ceasing at least half-time enrollment. A student must complete the FAFSA in order to be considered.

B. **University Long-Term Loans (ULTL).** Private donors contribute the funds for these

loans, which are awarded on the basis of need to undergraduate and graduate students. The interest rate of 5 percent begins with repayment of principal 6 months after ceasing at least half-time enrollment. Deferment provisions are available in some instances. A student must complete the FAFSA in order to be considered.

C. Federal Health Professions Loans and Scholarships. These programs are limited to those students accepted for enrollment in the College of Veterinary Medicine. The loan funds have a 5 percent interest rate. Deferment and cancellation provisions are available in some instances. The FAFSA is required, and parental information must be provided, regardless of age or dependency of the student.

D. University Emergency Loans. The Emergency Loan Program is intended to meet students' unplanned and unexpected education-related expenses. (These loans are not available to students who are enrolled only in off-campus courses.) Applicants must demonstrate that they have a verifiable means by which to repay their loans by the due date. Interest on emergency loans will begin on the date the loan is processed in the Treasurer's Office and is computed at the simple monthly rate of .75 percent of the unpaid balance (an annual percentage rate of 9 percent).

Emergency loan applications can be obtained at the Office of Student Financial Aid, Room 12, Beardshear Hall. Students should allow 48 hours for processing the emergency loan application.

E. William D. Ford Federal Direct Loans. Several types of Federal Direct loans are available to students.

1. The **Federal Direct Subsidized Stafford Loan** and the **Federal Direct Unsubsidized Stafford Loan** are low-interest loans made by the government to help pay for education after high school. Subsidized Direct Stafford loans will have all interest charges paid by the federal government while the student is enrolled in school on at least a half-time basis. The interest on the unsubsidized Direct Stafford loan will be the responsibility of the student and can be paid while the student is in school or added to the outstanding loan balance for payment after graduation.

To be eligible for a subsidized Direct Stafford loan, a student must show financial need. Students may borrow up to the amount of their need in the subsidized loan. The student may then choose to borrow any remaining amount, up to the federal maximum, in an unsubsidized Direct Stafford loan. Freshman students may borrow a combined total through either program of up to \$2,625 per year. Sophomore students may borrow up to \$3,500 per year, and junior and senior students may be eligible for up to \$5,500 per year, with a \$23,000 undergraduate maximum for all years combined. Graduate students may be eligible for up to \$8,500 per year, with a \$65,000 maximum, including all undergraduate loans.

For new borrowers, the interest rate is a variable rate which is tied to the 91-day treasury

bill plus 1.7 percent. The interest rate is adjusted annually and is capped at 8.25 percent. Repayment does not begin until six months after graduation. A FAFSA is required to apply for either the subsidized or the unsubsidized loan. Students are strongly advised to counsel with a financial aid adviser as increased loan indebtedness occurs.

2. Federal Direct PLUS Loan. The interest rate for Federal Direct Parent Loans for Undergraduate Students (PLUS) is tied to the 52-week treasury bill rate, with maximum interest being 9 percent. Through the Federal Direct PLUS program, parents may borrow the entire cost of education, less the amount of any financial aid the student is receiving. There is no limit on loan indebtedness, although a credit analysis will be conducted before funds can be disbursed.

3. Federal Direct Unsubsidized Stafford Loan for Independent Students. To be eligible, a student must be either an independent undergraduate student or a graduate/professional student. Eligible freshman and sophomore students may borrow up to \$4,000 per year. Eligible juniors and seniors may borrow up to \$5,000 per year, with a cumulative undergraduate maximum of \$23,000. Graduate/professional students may be eligible to borrow up to \$10,000 per year, with a cumulative total of \$73,000.

Eligible independent students who borrow through both the subsidized and the unsubsidized Federal Direct Stafford Loan programs and are freshmen can borrow up to a total of \$6,625 per year. Independent sophomores can borrow up to \$7,500 per year, and independent juniors or seniors, \$10,500 per year. Cumulative borrowing for undergraduate years could reach a total of \$46,000.

Eligible graduate students can borrow up to \$18,500 per year between the subsidized and the unsubsidized programs. Total indebtedness for a graduate student borrowing through both programs may not exceed \$138,500.

All students are strongly advised to discuss their loan indebtedness with a financial aid adviser before combining several types of loans.

H. Alternative Loans. Private financial institutions provide these loan funds, which are approved on the basis of a credit analysis. Amounts, interest rates, and repayment terms will vary, depending upon the financial institution selected. Interest will begin to accumulate immediately, although forbearance of the interest and principal can be made until after graduation. Some programs will require the student to obtain a credit-worthy cosigner. A FAFSA form is not required to apply for this loan.

III. Part-time Employment

A variety of employment opportunities are available for students to earn a portion of their educational expenses.

A. Federal Cooperative Education Program. This program combines classroom learning with paid work experience designed to develop students into the federal government's

future professionals and managers. The federal government seeks highly motivated, flexible, and creative students to fill co-op assignments across the country in laboratories, offices, forests, parks, hospitals, and in ocean and space programs in a wide variety of occupational fields. There are two different types of work schedules: alternate periods of work and study (full-time student one semester and full-time worker the next) or part-time (parallel periods of work and study). Students interested in the Federal Cooperative Education Program can contact the director of ISU Career Planning and Placement Services by calling 515-294-9490.

B. Internship Programs. Most college departments offer internship programs to enhance the student's education and career preparation by integrating classroom theory with on-the-job performance. These programs enable students to test career and professional goals; develop confidence, maturity, and work-related skills; and establish professional contacts and interests. Contact the respective department for specific program information.

C. Work-Study Programs. Both federal and state funds subsidize need-based programs that permit students to be employed on campus or off campus in nonprofit agencies. A portion of the student's total earnings is paid by federal or state funds, and the remainder is paid by the employing department. Students apply for Work-Study by completing a FAFSA by the priority deadline, and indicating that they wish to work. Look for your part-time job at www.iastate.edu/~fin_aid_info/employment

D. University Student Employment. University employment is available to all students who are U.S. citizens or to those international students who have obtained a work permit. Wages are paid 100 percent by the employing department. Many students who live in university residence halls apply for work in the residence hall food service to help meet the cost of room and board. Students interested in food service employment may apply directly to the assistant director of residence in charge of food service, Residence Department, Friley Hall, Iowa State University, Ames, Iowa 50012. Look for your part-time job at www.iastate.edu/~fin_aid_info/employment

E. Off-Campus Employment. The off-campus employment program seeks part-time employment opportunities for students who would like to work while they are in school. Restaurants, hotels, service stations, and retail stores are examples of local employers that list positions with the Student Employment Center. These jobs are available to any ISU student, graduate or undergraduate, regardless of financial need. Job listings can be found at www.iastate.edu/~fin_aid_info/employment

IV. Other Financial Aid

Many other forms of financial aid are available to students who qualify, including Vocational Rehabilitation, Veterans Benefits, and Department of Human Services programs. For further information on these programs, contact the appropriate government office.

Student Housing

Director: Randy Alexander, M.S.

Associate Directors: Virginia Arthur, Ph.D. (Residence Life); Stewart Burger, M.S. (Dining Services); Carlton Moen, Ph.D. (University Student Apartments); Gary Schwartz, M.A. (Residence Operations)

Assistant Directors: James Judy (Facilities Planning); Doug Gruenewald, Ph.D. (Academic Services); David Popelka, Ph.D. (Business Operations)

The university provides residence hall housing facilities for approximately 3,000 single undergraduate women, 4,000 single undergraduate men, 325 single graduate men, and 175 single graduate women. In addition, there are 956 family and single student apartments.

Each newly admitted student to the university will receive a housing application form following his/her admission. The student's name will be placed on a list for room assignment according to the date the completed application and application fee are received in the Department of Residence Administrative Office. Admission to the university is necessary before a housing application will be accepted.

Address correspondence concerning residence halls to the Administrative Office, Department of Residence, 1215 Friley Hall, Iowa State University, Ames, Iowa 50012. For information regarding family or single apartments contact the Director of University Apartments, 100 University Village, Ames, Iowa 50010. You may e-mail us at halls@iastate.edu or apartments@iastate.edu or call us toll free at 800-854-9050. Additional information may be obtained via www.public.iastate.edu/~residence_info/.

Undergraduate Residence Halls

Most of the rooms in residence halls are planned for double occupancy; however, some of the rooms accommodate three persons, and there are a limited number of private rooms. All rooms are furnished with single beds, innerspring mattresses, chest of drawers, individual study desks, chairs, telephone, and a cable television connection. An ethernet connection is available for a fee. Students provide their own bed linens, throw rugs, blankets, pillows, towels, and study lamps (except Maple, Willow, and Larch Halls where study lamps are furnished). Students are responsible for maintaining the cleanliness and order of their own rooms.

Housing options include (1) room provided for academic year excluding academic breaks; (2) room provided for academic year including breaks; and (3) room provided for full calendar year including breaks (Union Drive-Friley only).

Cafeteria-style food service is provided for all residents in the halls. Students living off-campus may purchase a residence hall meal plan. These meal plans may be purchased at 1215 Friley Hall. Meal plan options include the following:

20 meals per week (3 meals per day, except Sunday evening meal)

15 meals per week (3 meals per day, Monday-Friday)

14 meals per week (any 2 meals per day, Monday-Sunday)

10 meals per week (any 2 meals per day, Monday-Friday)

A single student who resides in an undergraduate residence hall must sign a contract for room and board for the academic year or the remainder thereof if contract is signed after fall semester begins. All charges are subject to change. The rate for the academic year 1998-99 was \$3,958 for a double occupancy room and full meal plan.

Students may move out of the residence halls at any time during the academic year upon payment of room and board for the term of occupancy plus forfeiture of the prepayment and a charge of 8 percent of the remainder of the contract if the student remains enrolled. If there are any questions concerning the residence hall contract, each student is encouraged to check with the administrative office (1215 Friley Hall) before making the final decision.

In addition to the basic necessities, several special facilities are available for use by residents. These include house dens for informal get-togethers and relaxing, student government-purchased TVs, newspapers, magazines, lounge areas for meeting and entertaining guests, vending areas for snacks, hall desks with fax and copy machines, entertainment and recreational equipment, mail delivery and check in and check out location within the residence halls, indoor and outdoor recreation areas and intramural equipment owned by student government, fitness centers, coin-operated laundry facilities in each hall, special study areas in each complex, private dining rooms for specially prepared house and organization dinners, meeting rooms and offices for student organizations, music listening and practice rooms, computer labs and parking lots assigned to the residence halls.

The residence halls are organized geographically into three autonomous student associations: The Towers Residence Association (TRA), the Richardson Court Association (RCA), and the Union Drive Association (UDA). The students in each of these coeducational associations elect a group of executive officers who are responsible for coordinating association events and activities. Each association funds and maintains a social program, an intramural program, and numerous committees that supplement the total social educational development of the individual residents. The three associations also are joined in an Inter Residence Hall Association (IRHA) with an all residence hall parliament; they jointly sponsor the KURE FM stereo radio station, Residence Hall Week, weekly movies, scholarships, leadership conferences, etc.

Each association is further organized into smaller living groups called houses. These houses of 55 to 75 members are the foundation of Iowa State University's residence hall program. Members of the houses elect their own officers and the majority of all programs are planned on a house participation basis. The individual's educational experience is augmented by active participation in the total house program.

The residence halls include 15 co-ed houses. These houses have male and female students living at opposite ends of the house. They have separate bathroom facilities, but share lounge facilities and house activities.

A variety of special interest housing options are available within the residence halls. Special interest housing includes coed houses, quiet houses, nine and twelve month continuous occupancy houses, a cross-cultural house, alcohol-free houses, and smoke-free houses. Learning communities, which bring together students who have similar academic goals, are also available in the residence halls. These communities offer a collaborative living and learning environment, increased student-faculty interaction, social and academic networks essential to student success, and a sense of membership in the ISU community. Currently, the following learning communities are available: ACES (Agriculture Community Encourages Success); BEST (Biology Education Success Team); CCLC (Cross-cultural Learning Community); Computer Engineering; Design Exchange; Honors; LEAD (Leadership Through Engineering Diversity); and WISE (Women in Science and Engineering). New learning communities are being developed. For an updated listing of special interest housing, please contact the Department of Residence, 1215 Friley Hall, Ames, Iowa 50012 or call 1-800-854-9050.

Graduate and Adult Undergraduate Residence Halls

Buchanan Hall provides housing in 174 single-occupancy rooms and 108 double-occupancy rooms for single graduate students and single adult undergraduate students. A suite-type room plan provides a semiprivate bath shared by the occupants of two single-occupancy rooms or two double-occupancy rooms. Public areas include a lounge, television room, recreation area, vending room, laundry room, and hall desk. All student rooms are air-conditioned and open for occupancy all twelve months.

Rooms in Buchanan Hall are furnished with single beds, mattresses, chest of drawers, window drapes, individual study desks, chairs, and telephone service. An ethernet connection can be activated for a fee. Students provide their own bed linens, towels and study lamps. Custodial service is provided weekly.

The room rate in Buchanan Hall as of July 1, 1998 was \$244 per month for a double room, or \$316 per month for a single room. A meal plan may be purchased for residence hall dining centers with the same options available as for undergraduate students.

University Student Apartments

The university provides 956 apartments in Hawthorne Court, University Village, and Schilleter Village. Rates for these apartments as of July 1, 1998, were \$365 per month for Hawthorne Court, \$364-\$390 per month for University Village, and \$411 per month for Schilleter Village. The apartments are furnished with stove and refrigerator. Rental rates include cable television, water and garbage removal service. Residents pay for their own gas, electricity and telephone.

Applications for University Student Apartments will be accepted not more than one year in advance of the semester of assignment. Applicants must be admitted to Iowa State University to apply for housing.

To be eligible for a university apartment applicants must be registered for classes during the semester of move in. Preference for housing is given to the following groups in order of priority:

- single parents living with dependent children
- legally married couples residing together with or without dependent children
- single students with up to three roommates (single student leases must be renewed annually.)

Address correspondence concerning student apartments to University Student Apartments, 100 University Village, Ames, Iowa 50010; Fax: 515-294-0651 or E-mail: apartments@iastate.edu.

Off-Campus Housing for Students

Availability and cost are factors to be considered when living off campus. Sleeping rooms in older houses, apartments, and duplexes make up the bulk of off-campus housing.

The Off-Campus Center, B6 Memorial Union, keeps a partial listing of off-campus rental units. Other housing may be obtained through real estate agents, local newspapers, or by contacting individual owners.

It is best that the student come to Ames well in advance of the time he or she plans to begin academic work, as many units are rented 3 to 6 months in advance. The single occupancy room rental rates average \$150 to \$200 per month. Average rental rate per student sharing an apartment or house would be in the \$200 to \$250 range per month. Board for students living in off-campus rooms may be obtained in residence hall dining rooms, private restaurants, or the Memorial Union.

A meal plan is available in the Department of Residence to off-campus students that provides any one meal per day, Monday through Friday, while classes are in session. Information may be obtained from the Administrative Office, Department of Residence, 1215 Friley Hall, Iowa State University, Ames, Iowa 50012-0003.

Fraternities and Sororities

Of the 57 fraternity and sorority chapters on the Iowa State University campus, 44 have chapter houses, and provide housing for about

1,800 undergraduate students. The eight historically black Greek fraternities and sororities do not provide residential facilities for members, but are active in scholastic, service, and social projects.

The chapter house facilities are similar to a private residence: living room, den, kitchen, dining room, laundry room, etc. The Greek Affairs staff in the Student Organizations and Activities Center provide advising, programs, and services for the Greek chapters and organizations. Local alumni work with each fraternity and sorority to ensure that the chapter structure meets all the state and local building, safety, and fire codes that are required with incorporation under the State Law of Iowa.

The average cost of living in a fraternity or sorority chapter house ranges from \$100 less to \$100 more per year than living in the residence halls. The cost includes room, board, and social dues. Fees average \$50 for a pledging fee and \$150 for the initiation fee.

Men may move directly into a fraternity house at the beginning of an academic year if they pledge a chapter that has a house. Typically, they continue living there throughout their college careers. Women pledging a sorority during formal rush or informally throughout the year generally live in the residence halls for the academic year. However, as space becomes available in a chapter house, sorority members often move into the house as sophomores or upper-class women.

If a student moves into a chapter house from the residence halls and has to break a contract, the student will forfeit the deposit and owe a percentage of the cost of the contract. Most of the chapters compensate a student to a degree. Because the compensation amount differs among houses, a student should communicate with the chapter before changing residences.



Student Services

The University Library

Dean of Library Services: Olivia M.A. Madison, M.L.A.

General Information—(515)-294-3642

Library Hours—(515)-294-4849

The University Library provides a wide array of print, non-print, and electronic information resources, which are housed in the main Parks Library, the Veterinary Medical Library, and four subject-oriented reading rooms (design, economics and sociology, mathematics, and physical sciences). The library's extensive collections support research and study for all ISU graduate programs, with the strongest support at the Ph.D. level. These collections are nationally recognized for their strengths in basic and applied fields of biological and physical sciences. Library holdings include more than 2,100,000 volumes and approximately 22,000 serial subscriptions.

The library encourages use of its collections and many services, and assistance is provided at ten public service desks. These desks include the Reference Desk, the Reserve Desk, Interlibrary Loan, the Circulation Desk, the Periodical and Newspaper Room, the Microforms Center, the Media Center, Special Collections, the Map Room, and Document Delivery/Photoduplication. In addition, instruction in the use of library resources is offered to graduate and undergraduate students.

SCHOLAR, the library's online information system, provides access to the local online catalog, which contains records for most of the book collection and all cataloged serials; several indexing and abstracting databases; and other selected university library catalogs. Additional indexing and abstracting databases and a variety of Internet resources are available through the library's web page (www.lib.iastate.edu), which is accessible through many specialized SCHOLAR research workstations in the library, and through the Internet using Netscape. In addition, more electronic resources are available in the library by using individual computer workstations and commercial information services. Assistance in using this vast body of electronic resources is available at the Reference Desk and through individually-arranged appointments with reference librarians.

Student Counseling Service

Director: Terry Mason, Ph.D.

Assistant Director for Clinical Services: Nancy Corbin, Ph.D.

Professional Staff: Patricia G. Andersen, Ed.D.; Jeanne Burkhart, Ph.D.; Michelle P. Clark, Ph.D.; Janet S. Croyle, M.Ed.; Ronald A. Jackson, Ph.D.; Marty I. Martinez, Ph.D.; H. Brooks Morse, Ph.D.; Martha S. Norton, M.S.; Paulette M. Stronczek, Ph.D.; Joseph R. Triggs, Jr., Ph.D.; Suzanne Zilber, Ph.D.

The Student Counseling Service (SCS) assists students in enhancing their academic and personal well-being with a staff of professional psychologists and counselors. Services are available to help students sort through their feelings, strengths, and options to develop new perspectives and coping skills.

Available services include individual counseling, relationship/couples counseling, career counseling and exploration, substance abuse assessment, and learning disabilities screening. Group counseling is also available for a variety of issues including adult children of alcoholics, depression, eating disorders, self-esteem and relationships, problem solving, and relaxation/stress management. SCS also offers a number of outreach programs and workshops.

Counseling services are offered at no cost to ISU students. However, a nominal fee for testing may be required. Counseling is strictly confidential. SCS staff will not release any information to anyone outside of the Student Counseling Service without the written permission of the client.

In addition to providing counseling and outreach services to students, SCS provides training and consultation to faculty and staff to assist them in addressing the psychological needs of students.

During the fall and spring semesters, SCS hours are Monday through Thursday, 8 a.m.–6 p.m. and Friday from 8 a.m.–5 p.m. During the summer (and when classes are not in session) office hours are Monday through Friday, 8 a.m.–5 p.m. The Student Counseling Service phone number is 515-294-5056.

Student Health Center

Interim Director: Mark Blaedel, M.D.

Physicians: Mark Blaedel, M.D.; Charlotte Cleavenger, D. O.; Rebecca Fritzsche, M.D.; Malhar Gore, M.D.; Pauline Miller, M.D.; Cosette Scallon, M.D.; Marc Shulman, M.D.; Lee Wilkins, M.D.

Jolene Nelson, P.A.C.

The Student Health Center is located in the Student Health Center west of Beyer Hall. Services include doctor and nurse consultations, physical exams, laboratory and x-ray services, trauma care, sports medicine and physical therapy, immunizations, pharmacy, diet and nutrition consultation, fitness consultation, computerized health risk appraisal, stress management, wellness assessment, workshops, free and confidential HIV testing, and referral services.

A \$47 student health fee, which partially finances the services of the Student Health Center, is charged to all students taking 5 or more credits each semester. Those taking 4 or fewer credits may also access services at reduced cost by electing to pay the health fee. Spouses/domestic partners of students who have paid the health fee may also pay the fee and have access to the same services. Students with less than 5 credits who elect not to pay the health fee may still be seen at the Student Health Center, but will be charged for the services provided. International students and their spouses/domestic partners are required to participate through payment of the health fee. This fee is not a substitute for health insurance. It is a prepayment plan that complements the student's individual insurance coverage.

Clinic hours are Monday through Thursday, 8 a.m.–8 p.m., Friday, 8 a.m.–6 p.m., Saturday, 8 a.m.–12 noon. Hours vary during breaks. Patients are seen by appointment. Each patient has the option of seeing the provider he/she requests. Injuries and illnesses may be seen on a walk-in basis. For more information, call 515-294-5801.

Service is available for emergency problems after regular clinic hours. After hours care is available in the north end of the Student Health Center until 10 p.m. daily. It begins at noon on Sundays. After 10 p.m. and until 8 a.m., emergency services are available at Mary Greeley Medical Center Emergency Room. The cost of such care is the responsibility of the student and/or the student's insurance plan.

All records are confidential. Student records are not available without the student's written permission.

Career Services Offices

Director: Beverly S. Madden, M.S., 12 Alumni Hall

Agriculture: Michael Gaul, B.S., 141 Curtiss

Business: Steven Kravinsky, M.S., 208 Carver

Design: Margaret Hutcheson, M.Ed., 297 College of Design

Education: Career Services, E105 Lagomarcino

Engineering: Larry Hanneman, M.S., 200 Engineering Annex

Family and Consumer Sciences: Beverly Kruempel, Ph.D., 131 MacKay

Liberal Arts and Sciences: Steven Kravinsky, M.S., 208 Carver

Veterinary Medicine: Eldon Uhlenhopp, Ph.D., 2520 Veterinary Medicine

Career Services (placement) offices are operated in each college to assist students and alumni with their career-related needs. They deliver a broad range of programs and services, including online on-campus interview scheduling; coordination of co-op and internship programs; credential/ reference services; workshops and seminars on subjects such as career exploration, résumé preparation and letter writing, off-campus job search techniques, interview skill building, preparing for the interview trip, summer job search strategies, applying to graduate and professional schools, obtaining government jobs, values clarification, and adjusting to your first job.

Each year career services sponsors five college career information days, a graduate/professional school day, an international opportunities festival, and three internship/summer job fairs. Each office also maintains a library of career-related resource materials and company

information. Alumni services are available to graduates in all colleges. Each career service office serves as a point of entry to the entire ISU network of career services.

Office of Minority Student Affairs

Director: Rafael Rodriguez, M.A.

Program Assistants: Meaghan Kozar, B.A.; Irma White, B.A.

The Office of Minority Student Affairs is designed to give leadership to the university's mission in the area of equal educational opportunity. The office strives to maximize the educational and personal growth of students by identifying and assisting in the development and promotion of programs which will enable students and staff to achieve their fullest potential.

In addition, the Office of Minority Student Affairs works closely with all units in the university to achieve the following objectives:

1. Strengthen Iowa State University's efforts in recruiting, retaining, and graduating ethnic minority students.
2. Work in collaboration with Minority Liaison Coordinators in reviewing the concept of equal educational opportunity and recommend changes in university policies that may limit or prevent the achievement of educational and cultural goals of minorities.
3. Ensure access and persistence of minority students in every discipline and area of study offered by the university.
4. Maintain liaison with all departments and organizations interested in the growth and development of students.

These objectives are designed to assist in the achievement of the major purpose of the Office of Minority Student Affairs: the identification, recruitment, retention, graduation, and placement of minority students. This purpose is accomplished through the following programs:

Carver Academy Program, George Washington Carver Scholarships, Martin Luther King, Jr., Loan Program, American Indian Symposium, ethnic cultural celebrations, Early Success Program (ESP), College Bound activities.

International Students and Scholars

www.public.iastate.edu/~internat_info/

Study Abroad Resource Center;
www.iastate.edu/~study-abroad/

Director: Dennis Peterson, M.A.

Assistant Director, International Students and Scholars: Brenda Thorbs-Weber, Ph.D.

Coordinator of Study Abroad Resource Center: Trevor Nelson, Ed.D.

Coordinator of International Services: Rebecca Matters

Special Projects Coordinator: Deborah Vance, M.B.A.

Program Coordinators: Luiza Dreasher, Ph.D.; Jane Edwards, M.S.; Ruth Ellis, B.A.; Ruth Osborn, M.A.; Lisa Sapolis, B.A.; Michelle Szabo, M.Ed.; Sidi Tandia, M.S.

International Students and Scholars is committed to courteous, accurate, timely service and informative programs for international students and visiting scholars, faculty, American students, and citizens of Iowa interested in international education. Internationals receive orientation, advice on personal concerns, U.S. visas, university procedures, and community resources from staff. Students seeking to study, work or travel abroad find a wealth of information at the ISS Study Abroad Resource Center. The Center has information on scholarships, travel, cultures, over 150 ISU programs and thousands of opportunities through other institutions. Staff, through Project Assist, aid ISU faculty in developing new study abroad opportunities for students in many majors. ISS intercultural programs bring international students and Americans together for mutual learning.



Dean of Students Office

www.public.iastate.edu/~deanstdt_info

Dean of Students: Kathleen MacKay, Ph.D., Student Services Building

Associate Dean of Students: W. Houston Dougharty, M.A., M.Ed., Student Services Building

Assistant Dean of Students: Vernon Wall, M.S., B6 Memorial Union

Academic Success Center

Interim Director: Gwen Woodward, M.S., Student Services Building

Coordinator, Disability Resources: Joyce Packwood, M.S., Student Services Building

Coordinator, Supplemental Instruction: Amy Rutledge, M.A., Student Services Building

Learning Disabilities Specialist: Gwen Woodward, M.S., Student Services Building

Adult Learner and Commuter Student Programs

Director: Penny Rosenthal, M.S., B6 Memorial Union

Program Assistant: Rob Wiese, B.S., B6 Memorial Union

Greek Affairs

Director: Brian Tenclinger, M.S., B6 Memorial Union

Judicial Affairs

Director: Grace Weigel, M.S., Student Services Building

Program Assistant: John Jobson, M.S., Student Services Building

Lesbian, Gay, Bisexual, & Transgender Student Services

Associate Dean of Students: W. Houston Dougharty, M.A., M.Ed., Student Services Building

Margaret Sloss Women's Center

Director: Pamela Thomas, M.S., Sloss House

Parents Association (ISUPA)

Associate Dean of Students: W. Houston Dougharty, M.A., M.Ed., Student Services Building

Recreation Services

Director: Larry Cooney, Ed.D., 107 State Gymnasium

Associate Director: Steve VanDerKamp, M.S., Lied Recreation Center

Business Manager: Scott White, M.S., 107 State Gymnasium

Coordinator, Intramural Sports: Garry Greenlee, M.S., 107 State Gymnasium

Program Coordinator, Intramural Sports: Linda Marticke, M.S., 107 State Gymnasium

Coordinator, Sports Clubs: Alan Murdoch, Ph.D., 107 State Gymnasium

Program Assistant, Intramural Sports: Randy Heimerman, M.Ed., 107 State Gymnasium

Coordinator, Fitness Programs: Jennifer Johnstone, B.S., 107 State Gymnasium

Manager, Outdoor Recreation: Audra McBride, M.A., 107 State Gymnasium

Program Assistant, Facility Operations: Rhonda Fritsche, M.S., Lied Recreation Center

Administrative Specialist, Facility Operations: Kathy Berrett, Lied Recreation Center

Manager, Facility Operations: Gary Pejsha, Lied Recreation Center

Student Activities Center

Assistant Dean of Students: Vernon Wall, M.S., B6 Memorial Union

Assistant Director, Student Activities: Laura Bestler, M.S., B6 Memorial Union

Student Activities Specialist: Dave Haden, M.S., B6 Memorial Union

Student Advocacy

Associate Dean of Students: W. Houston Dougharty, M.A., M.Ed., Student Services Building

Student Legal Services

Student Legal Advisor: Paul Johnson, J.D., B11 Memorial Union

Student Legal Advisor: Michael Levine, J.D., B11 Memorial Union

Student Support Services

Director: Mariam A. Hodari, M.A., Student Services Building

Program Assistant: Patti Rix, M.A., Student Services Building

Program Assistant: Deb DeWall, M.S., Student Services Building

Women's Center

Women's Center Coordinator: Pamela Thomas, M.S.

The Dean of Students Office (DSO), comprised of 13 different units in seven different campus locations, provides a wide array of services and programs outside of the classroom that enhance each student's education at Iowa State. Its goal is to support the University's commitment to academic success and the holistic development of each individual student by challenging students intellectually, physically and socially.

The DSO coordinates a variety of services that are each distinct and different, but nonetheless similar in their orientation toward maximizing students' educational opportunities.

Staff members in the various units of the DSO serve as advocates for students who may need assistance with their personal adjustment to college, with academic problems, or with interpretation of university or legal policies and procedures. These advocacy and other special services also are provided for students in particular populations, such as: those

with disabilities; adult and off-campus students; lesbian, gay, bisexual, and transgender students; first-generation college students; and women students. Educational programs and workshops in the areas of leadership, time management, and interpersonal skills are presented on an on-going basis and when requested by campus groups. Recreation Services provides a wide variety of intramural and recreational activities for all skill levels. Activities and programs for and about women are facilitated by the Women's Center. The Student Activities Center (SAC) registers and provides services and programs for student organizations and Greek Affairs coordinates fraternity and sorority chapters.

Academic Success Center (ASC)

The Academic Success Center encompasses several academic assistance programs. The services available at the ASC include the following: resources for students with disabilities; course-specific Tutoring and Supplemental Instruction; general walk-in assistance through the Academic Learning Lab, providing individual consultations for those with acute needs and study skills/time management presentations; and a one-credit study skills class (Psychology 131). All programs are focused on helping students learn how to learn and achieve their academic goals.

Disability Resources (DR) coordinates those support services that students may need in order to reach their fullest academic potential. The DR staff members serve as a resource within the university community concerning students who have physical or learning disabilities. DR provides advocacy, information, support, counseling, education, referral, and awareness to students, faculty, staff, the Ames community, and the state of Iowa. Call 515-294-1020, VTDD 515-294-1021, for further information.

The mission of Tutoring is to enhance academic growth, to remove barriers to learning, and to promote human worth and dignity in ways that are enabling, professional, and service-oriented. Tutoring is the process by which students can get more individualized instruction for undergraduate courses offered at ISU. Tutoring recruits and screens tutors, works out convenient times to meet, collects fees, and pays tutors. For information call 515-294-6624.

Supplemental Instruction (SI) is a free academic assistance program for very difficult courses, particularly in sciences and social sciences. Peer SI leaders who have demonstrated competence in the course, attend classes and conduct bi-weekly sessions to help students learn and study the course material. A complete schedule can be viewed on the Web, www.public.iastate.edu/~deanstdt_info/SI.html.

The Academic Learning Lab (ALL) is a "learning how to learn" center. A walk-in service to students, ALL helps them with tips on how to succeed in the classroom. ALL is staffed with psychology graduate assistants who work with students to pinpoint areas in their study strategies that might need improvement. Other

learning assistance is provided through a one-credit study skills course, Psychology 131, that addresses learning issues as well as a variety of reading and study strategies and tactics from time management to test taking. It is offered each semester and class size is limited to 20 students to allow for group interaction as well as individual attention.

The Office of Adult Learner and Commuter Student Programs

Through various programs and services, the Office of Adult Learner & Commuter Student Programs seeks to meet the unique needs of current and prospective adult, commuter, and off-campus students. This is accomplished through the following:

- Providing information and consultation about tenant/landlord rights and responsibilities
- Serving as a clearinghouse for general campus and city information and referral
- Advocating for campus-wide awareness and responsiveness to the needs of current and prospective adult, commuter, and off-campus students
- Offering opportunities for interaction and connection for adult and commuter students
- Offering leadership opportunities to student employees and interns

The office is funded in part by the Government of the Student Body.

For assistance and information, visit B6 Memorial Union, call 515-294-2364, or view www.public.iastate.edu/~offcampus_info.

Greek Affairs

The Office of Greek Affairs oversees ISU's fraternities, sororities, and affiliated Greek organizations. Greek Affairs provides advising, consultation, and educational services to the fraternities and sororities at Iowa State. Professional staff and graduate assistants work with student leaders, members, and chapter advisers to provide support to the chapters and to advise Interfraternity Council, Panhellenic Council, National Panhellenic Council, Greek Week, Dance Marathon, Fall Blood Drive, and other student organizations and activities affiliated with the Greek community.

The 53 fraternities and sororities at Iowa State University have approximately 3,000 student members (1,800 men and 1,200 women), or about 14 percent of the undergraduate student population. The Greek Affairs staff and local alumni work with each fraternity and sorority to ensure that the chapter is meeting the educational objectives of the university, their national affiliates and the developmental needs of the student. Fraternities and sororities have been active with Iowa State University since 1875. Since that time, many of Iowa State's total alumni have graduated with fraternity or sorority affiliation. For more information visit B6 Memorial Union, call 515-294-1023, or view from the web, www.public.iastate.edu/~deanstdt_info/greek/ga_home.html.

Judicial Affairs

The Office of Judicial Affairs is responsible for the university's Centralized Judicial System. Representatives from the Office of Judicial Affairs interpret university policies and conduct student disciplinary hearings for academic and non-academic violations of the ISU Student Conduct Code. As members of the Iowa State University community, all students have certain rights and responsibilities. When an alleged violation of the Conduct Code occurs, a hearing officer from Judicial Affairs investigates the complaint, interprets general university regulations and guidelines, conducts student discipline hearings which ensure the standards of due process, and consults with faculty, staff, and students regarding student conduct issues.

Student discipline hearings are conducted in accordance with the rules and regulations as set forth in university policies and procedures. Disciplinary hearings are administered by a member of the Judicial Affairs staff or by members of the All-University Judiciary (AUJ) committee, depending on the severity of the case. The Office of Judicial Affairs serves as a resource for anyone with questions regarding a student conduct issue and is located in the Dean of Students Office, 210 Student Services Building, 294-1021, www.public.iastate.edu/~deanstdt_info/ja/homepage.html.

Lesbian Gay Bisexual Transgender Student Services (LGBTSS)

LGBTSS is a safe space for all members of the ISU community to explore aspects of sexual orientation and gender issues in an open non-judgmental atmosphere. LGBTSS is committed to providing information and education that enhances the educational experience and overall quality of student life on campus.

LGBTSS, its staff, and advisory board work to promote advocacy, support, visibility, and diversity through programming, a variety of services, and referral. In achieving its mission, LGBTSS strives to promote full inclusion of LGBT persons and their allies at ISU and to eliminate homophobia, heterosexism, and sexism on campus.

Programs and services of LGBTSS include the speakers bureau, Lavender Graduation, National Coming Out Days events, supporting campus LGBT organizations, the Safe Zone sticker project, the lending library, and brochures and workshops on various LGBT issues. For more information: 224 Student Services Building, 515-294-5433, lgbtss@iastate.edu, or www.public.iastate.edu/~deanstdt_info/lgbss_home.html.

Margaret Sloss Women's Center

The Margaret Sloss Women's Center promotes the educational, personal, and career development of all women in the ISU/Ames community. Along with other departments, the Women's Center shares the university's responsibility of creating a safe and supportive environment for all individuals. The purpose of the Women's Center is to promote and sustain women through advocacy, programs, and information and referral services. The Women's Center provides:

- A clearinghouse of information including a lending library, resource files, a newsletter entitled Womenews, a calendar of events, and magazines including Ms., Essence, Working Woman, Curve, Connexions, Mother Jones, About Women on Campus, and Harvard Women's Health Watch.
- A program center that focuses on helping students, staff, and faculty thrive in an academic environment by motivating them toward a greater understanding of, and involvement with, women's issues. Educational programs presented in residence halls, departments and organizations include workshops on a variety of topics (e.g., self-esteem, images of women in the media, sexual assault, sexual harassment, domestic violence, dating violence, relationships between women and men, homophobia/heterosexism, sex roles and stereotypes, etc.).
- Coordination and co-sponsorship of special events including Women's Week, National Coming Out Day, Sexual Assault Awareness Week, Rosa Parks Day Celebration, and Women's History Month. Throughout the year, the Women's Center also sponsors a number of speakers on current issues, hosts conferences, and coordinates support and discussion groups.
- Advocacy and support for women who work toward changing situations which adversely affect them, both individually and institutionally.
- A space for women to meet, study, eat, network, discuss, find support, watch a video, or just relax.
- A place to gain experience and/or credit as a journalism or design intern, practicum student, student programmer, board member, or volunteer.
- Other services including an electronic breast pump, lockers to rent, free condoms, meeting rooms for campus and community organizations, kitchen facilities, and a TV and VCR.

The Women's Center is open Monday through Friday, 8 a.m.-5 p.m. and is housed in the Sloss House, located between Curtiss Hall and the Memorial Union. Call 515-294-4154 or view www.public.iastate.edu/~mswc.

Parents Association (ISUPA)

All parents of ISU undergraduate students are automatically considered to be members of the ISU Parents Association. The ISUPA serves as a link between the University and parents and families. Its mission is to serve and inform parents and to enhance the quality of student life at Iowa State.

There are no membership fees in the ISUPA; it is funded exclusively by contributions and fundraisers, like the annual tuition raffle. The ISUPA Board of Directors, comprised of 36 parents, along with members of the Dean of Students Office staff, administer the programs of the ISUPA, that include:

- Family Handbook, distributed to all new ISU parents at June orientation
- Parents Advisory Line (PAL), 1-800-772-8546, toll free assistance for parents
- Parent Calling Project, phonathon to new ISU parents each autumn
- Family Weekend, the annual fall event largely funded by the ISUPA
- Involvement in ISU admissions events

For more information on the ISUPA, call the Dean of Students Office, 294-1020 or the web site www.public.iastate.edu/~deanstdt_info/pa.html.

Recreation Services

Recreation Services is dedicated to the provision of quality recreational opportunities for the campus community. Programs include intramural sports, sports clubs, informal recreation, outdoor recreation, special events, fitness programs, and recreation facility scheduling. Assistance for other recreational services is provided.

The informal recreation program includes the opportunity for recreational sports activity in Beyer Hall, State Gymnasium, Forker Building (east campus), Lied Recreation/Athletic Center, outdoor tennis courts near the Physical Education Building, intramural fields east of the Towers and Maple-Willow-Larch Residence Halls, Clyde Williams Field and the southeast field complex east of the football stadium.

The fitness program provides several opportunities for staying fit. The types of aerobics classes available include: high/low impact, step, toning and water. The semester is divided into two sessions, each offering 35 classes. The Rec Milers Program is designed to help students stay interested and involved in a regular exercise program. Participants have the flexibility to choose their own activities and can exercise at their own pace and convenience. Participants keep track of their recreational mileage for each month. To get mileage credit, progress slips must be deposited in the Rec Miler's boxes at the Recreation Services Office, 107 State Gym, or at the Lied Recreation/Athletic Facility. Monthly totals for each participant are posted at State Gym.

Participants may earn awards for specific milestones. Aerobic activities for Rec Miler credit include: bike, walk, basketball, handball, cross country skiing, stationary bike, fitness class, jump rope, soccer, jog/run, swim, racquetball and tennis.

The outdoor recreation program is composed of four basic elements: the camping-outdoor equipment checkout program; the organized trip program; basic instruction activity workshops; the Outdoor Equipment and Resource Center. All of these programs and activities are designed to provide opportunities for natural environment experiences. Two regulation golf holes north of the Armory are open for ISU recreation golf use at no charge.

The sports club program is designed to serve individual interests in different sports club activities and is student-oriented in every respect. Sports clubs offer team or individual recreational opportunities. Following are the sports clubs: badminton, ballroom dance, bowling, cycling, equestrian, fencing, flying, frisbee, hapkido, hockey, judo, karate, kayak, lacrosse, racquetball, rifle and pistol, rodeo, rugby, sailing, scuba, ski, shotokan karate, sky diving, soccer, table tennis, tae-kwon-do, trap and skeet, volleyball, water polo, water ski, and weightlifting.

These clubs offer instruction and competition at the local and intercollegiate levels. The club members set dues, and most clubs receive financial subsidy from the Government of the Student Body to enable students to participate regardless of their financial situation.

The intramural program involves competition among participants who enter as teams or individuals and play according to specific schedules. There are a total of 50 intramural activities ranging from football to innertube water basketball and curling. Activities include men's, women's, and co-rec divisions.

Numerous special events add spice to the recreation program. These activities are of an endless variety and usually take place in a short time span. In general, they encompass demonstrations, performances, special contests, mass group participation, social occasions, excursions, displays, or special instruction.

Other physical, cultural, and social recreation programs are sponsored in coordination with various departments, organizations, and groups on and off campus. For further information concerning campus recreation activity, contact the Recreation Services Office, 107 State Gym, or call 515-294-4980, or www.public.iastate.edu/~rec_services_info/homepage.html.

Student Activities Center

The Student Activities Center is committed to student involvement and retention. Its programs and services, including substance abuse prevention, leadership development, and organization participation, strive to ensure student success. These practical experiences work toward enhancing the quality of student life. With over 500 organizations from which to choose, students learn about themselves and appreciate the diversity in others. The staff of the SAC is dedicated to utilizing their knowledge and experience to provide unique living and learning opportunities for all Iowa State students.

The SAC is responsible for registering over the 500+ student, campus, and community organizations. The staff provides consultative services to student leaders, members, and advisers of organizations on an individual and group basis. They also provide training workshops and facilitate retreats for student groups. This office produces Newsline, a newsletter distributed twice each semester to presidents and advisers of registered student organizations. The SAC also annually publishes the Student Organizations Resource Manual, which informs the campus community about university policies and procedures that affect student organizations. Information about substance abuse prevention and peer education training is a priority at Iowa State University and is provided through the SAC. The staff of the SAC also advises students involved in the Government of the Student Body (GSB) and VEISHEA.

For more information visit the SAC, B6 Memorial Union, 294-1023, or view http://www.public.iastate.edu/~deanstdt_info/soac_home.html.

Student Advocacy

When student life at Iowa State becomes overwhelming or situations arise when students need some advice, the staff of Student Advocacy is ready to help. The associate dean of students, along with his/her graduate student assistant and other DSO colleagues, provide resources for students to work through issues including:

- Academic concerns
- Personal concerns
- Personal and family emergencies, and
- Formal grievance procedures.

Assistance in understanding and navigating the University judicial systems and other university policies and procedures is also provided.

Personalized referrals to other University resources and services is key in providing proactive and comprehensive advocacy to students. Consultation and advocacy is provided in an atmosphere of confidentiality and concern for each student's personal well being and educational objectives. For more information visit Student Services 210, call 515-294-1020, or www.public.iastate.edu/~deanstdt_info/sa_home.html.

Student Legal Service (SLS)

Student Legal Services is a cost-free legal aid office available to any student currently enrolled at Iowa State and registered student groups. SLS is staffed by full-time, practicing attorneys who are available to consult with students and offer advice with respect to most legal problems. While SLS is a part of the Dean of Students Office, its financial support comes from the Government of the Student Body (GSB). The types of cases most often handled by the staff of the SLS include:

- Family Law and Divorce
- Criminal Law
- Landlord-Tenant Problems
- Off-Campus Employment Problems
- Consumer Issues
- Administrative Issues

However, SLS cannot actively represent students in controversies involving student vs. student, student vs. ISU, and ISU student judicial matters and does not handle the following cases: fee generating cases; felony defense; Federal Court matters; cases involving excessive time.

More information is available at SLS, Room B11 Memorial Union, 515-294-0978, www.public.iastate.edu/~deanstdt_info/sls.html.

Student Support Services Program (SSSP)

SSSP, a federally funded program, provides academic support to eligible students and is designed to increase the retention and graduation rates of low-income individuals who are first generation college or individuals with disabilities. The needs of the students who are accepted into SSSP are thoroughly assessed through testing and counseling. SSSP participants receive personal and career counseling, along with academic advice, tutoring, and assistance in receiving financial aid.

Participants in SSSP are encouraged to work with an SSSP student mentor to become acclimated to the ISU environment. These relationships also encourage participants to fully access ISU resources.

Study skills improvement sessions and basic skills instruction are provided in the areas of math and writing. In addition, cultural enrichment (i.e. theatre, dance and musical events) and educational (leadership conferences, graduate/professional, etc.) activities are planned. These services are provided free of charge to eligible students after they are accepted into the program. SSSP is located in the Student Services Building; call 515-294-0210 or view www.public.iastate.edu/~deanstdt_info/sssp_home.html, for further information.

Vocational Rehabilitation

The State of Iowa Division of Vocational Rehabilitation Services Office provides services to students who are able to provide medical documentation that they have a substantial impediment to employment. Rehabilitation services may include the following: medical assessment; vocational evaluation; counseling and guidance; special adaptive equipment or devices; financial assistance towards training; job placement assistance. No direct fees are charged, but there may be some costs through involvement with services. Financial assistance towards tuition costs is based on student financial need. For more information, contact Vocational Rehabilitation, 515-294-5059, 210 Student Services Building, www.public.iastate.edu/~deanstdt_info/vrc.html.



Student Life

Child Care

Child Care Resources, a unit of Human Resource Services, supports Iowa State University families by linking them with programs and services that can help meet their child care needs. The university child care consultant is available to assist families in accessing services available both on the campus and in the community.

Child care programs located on campus include:

- Center for Child Care Resources: Assistance in locating community child care services, 1038 Pammel Court, 515-294-8833 or 1-800-437-8599
- University Community Childcare at Pammel Court, 891 Pammel Court, 515-294-9838
- The Comfort Zone: Daycare for kids who don't feel so good, 1019 Pammel Court, 515-294-3333.
- Flex-Care: Part time care for children of ISU students, 1052 Pammel Court, 515-294-2471.
- University Child Care Center at Veterinary Medicine, 1700 Christensen Drive, 515-294-2273.
- ISU Child Development Laboratory School, Child Development Building, 515-294-3040.

For more information about child care options, contact the university child care consultant at 515-294-8827.

Forensics: Individual Events

ISU Forensics, the Iowa State speech team, participates in several kinds of competitive speech activities. Please contact Speech Communication Program at 515-294-7670 for further information.

Honor Societies

Alpha Epsilon—Agricultural Engineering

The purpose is to promote the high ideals of the engineering profession, to give recognition to those agricultural engineers who manifest worthy qualities of character, scholarship, and professional attainment, and to encourage and support such improvements in the agricultural engineering profession that make it an instrument of greater service to humanity. Membership is based on scholarship, leadership, and character.

Alpha Lambda Delta/Phi Eta Sigma — Freshmen

First-year students who achieve at least a 3.5 GPA for one or more semesters their first year may be members of these national honor societies. These societies encourage superior scholastic attainment among students in their first year at institutions of higher education.

Alpha Pi Mu—Industrial Engineering

Members are chosen for character, achievement, and scholarship in industrial engineering. The group provides social and educational interaction for industrial engineering.

Alpha Sigma Lambda

An honorary that recognizes achievements of outstanding undergraduate students in continuing education. Unlike many other honor societies, Alpha Sigma Lambda is open to part time students. Adult students taking classes at off campus sites are encouraged to apply for membership.

Alpha Upsilon Alpha—Education

An educational honorary that recognizes and encourages scholarship and leadership in the field of reading.

Alpha Zeta—Agriculture

Members must have completed three semesters of study in the College of Agriculture or Veterinary Medicine and be in the upper two-fifths of their class. Meetings are held to foster high standards of scholarship, character, and leadership. Alpha Zeta sponsors lectures, service projects, and promotes the agricultural programs at ISU.

Beta Beta Beta

A national organization for students in the biological sciences with a purpose to recognize undergraduates with exceptional scholarship, leadership and character.

Beta Gamma Sigma

Honor society for collegiate schools of business.

Cardinal Key—Senior Leadership

The Senior Honor Society of Cardinal Key recognizes those persons who have been outstanding leaders in college life, who have rendered noteworthy service to Iowa State, who are of high moral character, and who rank high scholastically. Members are selected by application and interview.

Chi Epsilon—Civil Engineering

The purpose is to develop the profession of civil engineering through the interaction of members, fellow civil engineering students, and faculty. Scholarship, character, practicality, and sociability are the fundamental requirements for membership.

Epsilon Pi Tau—Education in Technology

Members are selected from the upper one-fourth of the juniors, seniors, and graduate students in industrial technology. The group strives to promote skill, social and professional efficiency, and research.

Eta Kappa Nu—Electrical Engineering

Members are selected from the upper one-fourth of the junior class and upper one-third of the senior class in both electrical and computer engineering. Eta Kappa Nu promotes scholarship and citizenship through guest lectures and service projects.

Golden Key—All University

A national nonprofit academic honors organization, Golden Key is dedicated to recognizing and encouraging scholastic achievement in all undergraduate fields of study and to uniting collegiate faculty and administrators.

Kappa Delta Pi—Education

In an effort to promote excellence in and recognize outstanding contributions to education, Kappa Delta Pi maintains a high degree of professional fellowship among its members, quickens professional growth, and honors achievement in educational work. Membership invitations are extended to second semester sophomores, juniors, and seniors with a GPA of 3.25 or above.

Kappa Omicron Nu, Gamma Chapter

Objectives of the honor society are to promote graduate study and research, and to stimulate scholarship and leadership toward the well-being of individuals and families throughout the world. Top 10 percent of junior and top 20 percent of senior students maintaining at least a B average, and outstanding graduate students in family and consumer sciences, are eligible for selection. Research within the college is shared at monthly meetings.

Kappa Tau Alpha—Journalism

Kappa Tau Alpha is the national society dedicated to the recognition and promotion of scholarship in the field of journalism. Members are selected from the upper 10 percent of the senior class. Graduate students and faculty who qualify are also eligible for membership.

Omega Chi Epsilon—Chemical Engineering

Membership is open to chemical engineering juniors in the top 20 percent of their class, or seniors in the top 30 percent. The purpose is recognition and promotion of high scholarship, original investigation, and professional service in chemical engineering.

Order of Omega—Greek Affairs

A national Greek honorary, the Order of Omega was founded at Iowa State in 1957. Criteria for membership include character; scholarship; leadership; service to the individual chapter, the Greek system, the university, and the Ames community. Membership is limited to junior and senior students who comprise one percent of the Greek population.

Phi Alpha Theta—History

Students who have a B average in at least 15 hours of history are eligible for membership. The local branch sponsors social activities, co-sponsors prizes for undergraduate essays in history, and encourages students' participation in state-wide, regional, and national Phi Alpha Theta conferences.

Phi Beta Delta—International Scholars

Phi Beta Delta is a national honor society dedicated to recognizing and encouraging high professional academic and personal achievements in the field of international education. Members are selected from domestic and international students and from distinguished faculty and staff members on the basis of scholastic achievement and international activities.

Phi Beta Kappa—Liberal Arts and Sciences

Phi Beta Kappa is a national honorary society, founded in 1776 "to recognize and encourage scholarship, friendship, and cultural interests." Membership is by invitation to students enrolled in the LAS curriculum. To be eligible, juniors must have at least a 3.80 cumulative grade point average and seniors, at least a 3.60 average. Other criteria for membership include requirements in the mathematical disciplines and a foreign language.

Phi Delta Kappa—Education

Phi Delta Kappa is an honorary educational fraternity dedicated to research, service, and leadership. Membership is by invitation only.

Phi Kappa Phi—All University

This national honor society recognizes and encourages superior scholarship in all academic disciplines. Membership is open to qualified undergraduates and graduates by invitation and occasionally to faculty and alumni.

Phi Upsilon Omicron—Family and Consumer Sciences

Members are selected from junior and senior family and consumer sciences students who have demonstrated academic excellence and professional leadership qualities. Membership is a means of furthering professional goals. Outstanding graduate students are also eligible for selection.

Phi Zeta—Veterinary Medicine

Phi Zeta is the national honor society of veterinary medicine whose aim is to stand for the constant advancement of the veterinary profession, higher educational requirements, and high scholarship. Active members are students in the third and fourth year of the veterinary curriculum who have achieved high scholarship, and those who have been in possession of a veterinary medical degree for at least two years and are engaged in a veterinary graduate program, internship, or veterinary research.

Pi Alpha Xi—Horticulture

This honor society's purpose is to promote high scholarship, foster good fellowship, increase efficiency of the profession, and establish cordial relations among the students, educators, and professional horticulturists. Membership is open to academically qualified upperclass and graduate students in horticulture.

Pi Mu Epsilon—Mathematics

Pi Mu Epsilon is the national mathematics honorary society whose purpose is the promotion of scholarly activity in mathematics among students and staff. Members are students and faculty who have completed at least two years of college-level mathematics with honor (at least 3.33 GPA) and have maintained an overall GPA of at least 3.0.

Pi Tau Sigma—Mechanical Engineering

Members are juniors and seniors in the upper ranks of their classes in mechanical engineering. Meetings and social functions are held to recognize and encourage outstanding scholastic achievement.

Psi Chi—Psychology

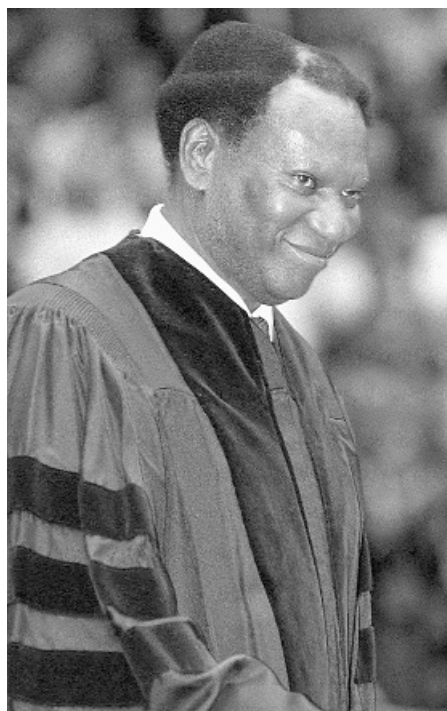
This national honor society in psychology recognizes and honors individuals maintaining high scholarship and documented interest in psychology.

Sigma Gamma Epsilon—Geological Sciences

The objectives of this national honorary society are the scholastic and scientific advancement of its members and the promotion of friendships and assistance among colleges, universities, and scientific schools devoted to the advancement of the earth sciences. Membership is intended for those scientists and students of science whose primary concern is the study of the earth.

Sigma Gamma Tau—Aerospace Engineering

Sigma Gamma Tau is the national honorary for aerospace-aeronautical engineering students who have displayed outstanding scholarship, leadership, and personal characteristics. Members are selected from the upper fourth of the junior class and upper third of the senior class who have maintained a 3.00 or better cumulative grade point average.



Sigma Lambda Chi—Construction Engineering

The purpose is the recognition of outstanding students in construction engineering. Upperclass students in construction engineering may be initiated into the society providing they have an overall scholastic average in the upper 20 percent of their class.

Sigma Xi—Research

Sigma Xi, the scientific research society, is a broad-based scientific honor society with over 500 chapters and clubs at universities and nonacademic scientific institutions. Sigma Xi awards associate membership to undergraduates and graduate students who have demonstrated research potential through participation in an original scientific research activity. Full membership in Sigma Xi recognizes a significant scientific research contribution.

Tau Beta Pi—Engineering

Tau Beta Pi honors engineering undergraduates, graduate students, and outstanding alumni who have distinguished themselves in scholarship and by exemplary character. Members are selected from engineering juniors in the upper eighth and seniors and graduate students in the upper fifth of their classes.

Upsilon Pi Epsilon

Honor society for computer science students.

Xi Sigma Pi—Forestry

Xi Sigma Pi recognizes outstanding juniors, seniors, graduate students and faculty members in forestry. The objective is to encourage high professional standards in the profession of forestry and to promote fraternal relationships among foresters.

Lectures

Throughout the academic year the Committee on Lectures brings to the campus a number of speakers eminent in national and international affairs, the sciences, and the arts. In addition to giving formal lectures, a number of these speakers meet with students informally for discussions. Through these lectures and discussions the students are given a well-rounded presentation on subjects and areas affecting their culture, educational and economic philosophy, and scientific development. Past speakers include scholars E.O. Wilson and Stephen J. Gould; activists Gloria Steinem and Anita Hill; actor and comedian Bill Cosby; poet Maya Angelou; and astronaut Sally Ride.

The Institute on World Affairs is an annual week of speakers and films on a topic of international interest held in the fall. Spring semester, the Institute on National Affairs is held with a topic of national concern as its focus. Focus, an annual fine arts festival with emphasis on student creativity in the arts, is held in the spring. The Committee on Lectures also sponsors or cosponsors dramatic, dance, and musical events. In addition, a film series is scheduled during summer session. Students are encouraged to contact the lectures program office and become involved in the planning of these events.

Memorial Union

The Iowa State Memorial Union is regarded as the heart of campus life and the campus center of informal education at Iowa State University. It is the meeting place and headquarters for most student organizations and houses several university functions. Lectures, exhibits, films, concerts, banquets, dances, and other campus gatherings are accommodated in its meeting rooms and ballrooms.

A food court with eight food concepts and a large variety of choices, the Cardinal dining room, catering service, and a 24-hour vending area provide food service to the university community. The Maintenance Shop hosts some of the finest in blues, jazz, rock, and folk music performances—as well as live theater productions. The Recreation Center offers bowling, billiards, pinball, and video games; also available is a large screen television, and quiet study lounges.

Art is a way of life in the Union that includes special film showings, galleries, and a browsing library that offers reading, music, and video materials. The Workspace studios are staffed and equipped for individuals who wish to express themselves creatively. A small, quiet chapel is available for services, weddings, or meditation.

Campus visitors may choose to stay overnight in the guest rooms on the third, fourth, and fifth floors. The Memorial Union also has a convenience store, automatic teller machines, a TicketMaster outlet, the University Book Store, a copy center, a full service post office, and an attached 640 car parking ramp.

Opened in 1928 as a proud memorial to the Iowa State men and women who served in the Armed Forces during World War I, the Memorial Union is now a living memorial to all Iowa Staters who have served in the United States military.

Motor Vehicles and Bicycles

Students are permitted to own and operate motor vehicles—automobiles, motor scooters, and motorcycles. Motor vehicles, however, are in no way necessary for an Iowa State University student. Those who operate a motor vehicle or bicycle must abide by the rather extensive traffic and parking regulations that are necessary because of the congestion on campus. All motor vehicles maintained, owned, or operated by students on university property are to be registered with the Parking Division Office located in the Armory. Fines are levied for infractions of these regulations.

Music Activities

Many opportunities to perform and listen to music are provided to Iowa State students. The Department of Music offers a full instructional program including applied vocal and instrumental instruction, music theory, music history and literature, and music education.

The Department of Music offers a wide variety of opportunities to participate in large performing groups, including five choral ensembles, six bands, ISU Symphony Orchestra, and numerous chamber groups. Nearly one-fourth of all undergraduate students participate in some aspect of music while attending ISU. Campus concerts, student operas, musical shows, the Holiday Festival of Music, the Madrigal Dinner, and concert tours are among the musical events offered.

Musical events by world renowned artists are presented throughout the year in the Iowa State Center. In addition, the Department of Music presents many faculty and guest artist recitals.

Sigma Alpha Iota and Phi Mu Alpha, professional music fraternities for women and men, are represented on campus.

Religious Life

Iowa State University is a state-supported, nonsectarian institution, but it recognizes the importance of spiritual life and cooperates with the many off-campus groups that fulfill the religious needs of the community.

Most of the larger denominations have churches within easy walking distance of the campus. A number of these have built attractive student centers in connection with the churches and conduct extensive student programs under the direction of professionally trained persons. In addition, a number of campus student organizations also address the religious needs of many students.

Theatre and Dramatics

The Iowa State University Theatre, Department of Music, produces a season of at least five major presentations each year. The season's bill endeavors to offer a variety of theatrical fare, including a musical, well-known dramatic literature and unusual and lesser-known plays. Practical experience in all phases of theatrical production is open to all interested, registered students within the university. The season is partially subsidized by an allocation from the Government of the Student Body; therefore, all students paying activity fees may purchase tickets to a performance at the reduced student price.

Other theatre-sponsored programs include student-produced plays, readers theatre programs, Theta Alpha Phi (a national dramatics honorary), the ISU Theatre Lab productions, the Minority Theatre Workshop, and the ISU Studio Theatre program.



Research Organizations

Research is an important activity at Iowa State University. Faculty members engage in research pursuits as well as teaching. Graduate students, and in some cases undergraduates, play an active part in this search for new knowledge.

Support for research at Iowa State University comes from state and federal appropriations as well as from contracts and grants involving the federal government and nonfederal organizations. As part of its total program, the university also operates extension services, special laboratories, centers, and institutes.

An abbreviated description of many of the various research organizations and their activities is presented here. Additional information concerning any of these organizations and student research opportunities they support may be obtained from their administrative offices.

Agriculture and Home Economics Experiment Station—

David Topel, director. The Experiment Station supports research in the biological, physical, and social sciences to contribute to the advancement of the agricultural industry and to improve the economic and social conditions of families and communities. Scientists in about 30 departments across campus work in campus laboratories, at 12 outlying research farms, and in the fields and business places of cooperators throughout the state. The station's work is organized into two dimensions—academic departments and research centers. The research centers focus on problems that require an interdisciplinary research effort. Research organizations administered by the station include:

•**Center for Agricultural and Rural Development (CARD)**—Bruce A. Babcock, director. CARD is devoted to agricultural economic policy research, education and publication in both domestic and international arenas encompassing four broad areas: trade and agricultural policy, natural resources and conservation policy, food and nutrition policy, and rural and economic development policy.

•**Iowa Beef Center**—John Lawrence, director. The purpose of this center is to enhance the vitality, profitability and growth of the beef cattle industry in the state.

•**Institute for Social and Behavioral Research**—Rand D. Conger, director. Research and educational efforts of the Institute for Social and Behavioral Research are directed toward improving the quality of life in Iowa's communities. The center improves cooperative efforts among universities, hospitals, businesses, and other state and community agencies in promoting rural health by expanding the knowledge base to develop and deliver innovative health promotion and care technologies; improves accessibility to health services; enhances the use of limited

health care resources; and provides collaborative research and educational programming opportunities in the area of rural health.

•**Leopold Center for Sustainable Agriculture**—Dennis Keeney, director. Named for conservationist Aldo Leopold, the center was established to conduct research on the environmental and social impacts of farming practices and to help develop and demonstrate profitable farming systems that preserve the productivity and quality of natural resources and the environment.

•**Midwest Agribusiness Trade Research and Information Center (MATRIC)**—Bruce A. Babcock, executive director. MATRIC is one of several international trade development centers established by the USDA. It was founded in 1987 as a joint effort of ISU and the Greater Des Moines Chamber of Commerce to link the research capabilities of the university with the needs of agribusiness in Iowa and surrounding states. The center is working to enhance trade in agricultural products produced by small-to-medium-sized businesses in the Midwest.

•**North Central Regional Aquaculture Center**—Joseph E. Morris, associate director. This center is administered jointly by Michigan State University and Iowa State University. It is one of five regional centers established to develop collaborative interstate research and cooperative extension programs for commercial aquaculture—the culture or husbandry of aquatic organisms under controlled conditions.

•**North Central Regional Center for Rural Development**—Cornelia B. Flora, professor in charge. The center is supported by the land-grant universities of the North Central Region and the U.S. Department of Agriculture. The major purpose of the center is to conduct a multidisciplinary research and extension program addressed to improving the social and economic opportunities of both farm and non-farm people of rural America.

•**North Central Regional Plant Introduction Station**—Mark Widrechner, acting research leader. One of four regional centers, the station is a joint venture among the USDA Agricultural Research Service, 12 north-central states, and the Iowa Agriculture and Home Economics Experiment Station. The station's three main areas of activity are: (1) to grow and store seed to maintain viability of the seed collection, (2) to conduct research, and (3) to serve as a distribution center for plant scientists.

•**Nutritional Sciences Council**—Steven Nissen, chair. The Nutritional Sciences Council consists of faculty members and qualified collaborators who are engaged in research, extension, or teaching in the nutritional sciences and closely related disciplines. The council develops symposia on topics of international interest, sponsors an interdepartmental seminar,

“Modern Views of Nutrition,” and arranges short courses designed to fill specific needs in the total nutrition program.

•**Seed Science Center**—Manjit K. Misra, professor in charge. The center is the focus of ISU activities related to seed. Activities include seed services; research; training seed specialists and seed scientists; and providing information to seed growers, conditioners, and sellers.

•**Utilization Center for Agricultural Products**—Dennis Olson, director. Increased utilization of agricultural products through development of new products, new markets, and new processing is the focus of the center. It strengthens and broadens programs in the following existing ISU programs:

1. **Center for Crops Utilization Research**—Lawrence A. Johnson, professor in charge. The center conducts basic research on crop properties and applied research directed at developing products and processes that will expand demand for food crops such as corn and soybeans, as well as demand for alternative crops. It also acts as a technology-distribution center for processors, export customers, and foreign scientists and visitors.

2. **Food Safety Consortium**—James S. Dickson, professor in charge. The Food Safety Consortium consists of researchers from the University of Arkansas, Kansas State University, and Iowa State University. It was established by Congress in 1988 to investigate meat production in the poultry, beef, and pork industries, from the farm to the consumer's table. The goal of the multidisciplinary program is to improve food safety.

3. **Meat Export Research Center (MERC)**—Dennis Olson, professor in charge. MERC conducts research to develop a stronger agricultural economy through increased exports of U.S. meats and meat products. Research areas include trade policy, cultural preferences in potential export markets, and development of meat products and processing technologies. MERC is a technology-distribution center for meat processors, export customers, and foreign scientists and visitors.

•**Ames Center for Animal Health (ACAH)**—James Roth, professor in charge. The purpose of the Ames Center for Animal Health (ACAH) is to further integrate and enhance animal health research and service activities at the animal health institutions in Ames to better serve the animal health needs of the state, the nation and the world. The ACAH is a cooperative effort between Iowa State University, the USDA Agriculture Research Service (ARS), National Animal Disease Center (NADC), the USDA Animal and Plant Health Inspection Service (APHIS), National Veterinary Services Laboratories (NVSL), and the USDA APHIS Center for Veterinary Biologics (VB). The ACAH was originally established as the Center for

Immunity Enhancement in Domestic Animals in 1987, and the name was changed to the Ames Center for Animal Health in October 1995. In April 1995, ISU and the USDA signed a Letter of Intent to work together to build the animal health infrastructure in Ames through the Ames Center for Animal Health. It includes the following five components:

- Expansion and consolidation of APHIS activities in Ames
- Construction of a biosafety level 3 large animal biocontainment facility that would be shared by ISU, ARS, and APHIS
- Development of a collaborative training program
- Formation of a technology transfer program
- Increased sharing of resources among animal health institutions located in Ames

Biotechnology Council—Walter R. Fehr, chair. The council, composed of faculty members engaged in biotechnology research from the colleges of Agriculture, Engineering, Family and Consumer Sciences, Liberal Arts and Sciences, and Veterinary Medicine, coordinates the university's interdisciplinary biotechnology program. Council responsibilities include establishing and operating university-wide instrumentation facilities for molecular biology research, recommending allocations of biotechnology funds, and assisting in public education, technology transfer, and economic development activities.

Carrie Chapman Catt Center for Women & Politics—Dianne Bystrom, director. This center offers leadership development and educational opportunities to women and men of all ages who are interested in politics, public administration and policy, and public service; it fosters research on issues related to women and politics; sponsors conferences, workshops and lectures on important national and international issues; and encourages women to pursue careers in politics, public administration, and public service.

Center for Designing Foods to Improve Nutrition—Diane Birt, director. The Center for Designing Foods to Improve Nutrition was established at Iowa State University to improve nutrition and health maintenance through a more integrated understanding of food selection and consumption; nutrient utilization; and food production, formulation, processing, and distribution. Research focuses on designing new foods; modifying food consumption; nutrient utilization; food safety; and policy alternatives and implications.

Center for Family Policy—Jacques Lempers, director. The purpose of this center is to address current and future policy issues, particularly focusing on infants, children, adolescents, adults and the elderly and their families and communities, whose quality of life is constrained by economic, social and/or developmental circumstances.

Center for Technology in Learning and Teaching—Ann Thompson, director. This center promotes, supports and facilitates research, development, use and evaluation of applications of technology which enhances learning and teaching.

Center for Transportation Research and Education—Thomas Maze, director. This center acts as a focal point to promote transportation education, research and extension on the ISU campus. It develops and implements innovative methods, materials and technologies for improving transportation efficiency, safety and reliability, while enhancing the educational experience of students in transportation-related fields.

Computation Center—Peter Siegel, director. The Computation Center provides academic computing and networking for the university. Instructional and research support ranges from microcomputing and local area networking to supercomputing and wide-area networking. The center's research computing group is active in the development of advanced computing techniques and aids researchers in efficiently carrying out the computing needed for research projects. The center also provides support for SCHOLAR, the library's on-line information system, and management services for Project Vincent, high-performance workstations networked via a high-speed campus backbone. In conjunction with off-campus network connections, Project Vincent provides computation capabilities for supercomputing, visualization, and numeric computation. In the increasingly distributed academic computing environment, the center seeks to promote computing standards and to achieve commonality of operations and economies of scale where appropriate.

Engineering Centers. The College of Engineering administers the following centers:

• **Analog and Mixed-Signal VLSI Design Center**—Randall L. Geiger, Director. The purpose of this center is to educate graduate students in the analog and mixed-signal VLSI field, to conduct research that will advance the state of the art in the field, to promote industrial interactions and codevelopment, to promote extended learning opportunities for off-campus students, and to provide substantive exposure to undergraduate students to analog and mixed-signal design issues.

• **Bridge Engineering Center**—Terry Wipf, manager. Faculty and student researchers at the Bridge Engineering Center study the design, behavior, repair, and rehabilitation of highway and railroad bridges. They work closely with state and national transportation departments and offer short courses and seminars on bridge inspection and rehabilitation for engineering professionals.

• **Center for Building Energy Research**—Howard N. Shapiro, manager. The Center for Building Energy Research develops new technologies and improves existing ones to help reduce energy consumption while maintaining performance and productivity. In joint efforts with industry and government, center researchers develop refrigeration equipment that can allow for a rapid shift to new, efficient, and environmentally desirable refrigerant fluids. The center also provides opportunities for technical and continuing education for engineering students, practitioners, building operators, and others involved in building energy management.

• **Center for Interfacial Materials and Crystallization**—Glenn L. Schrader, manager. The Center for Interfacial Materials and Crystallization researches the chemical and physical phenomena that occur at interfaces—the thin films or layers at the boundaries between solids, liquids, and gases. The properties of these interfacial materials are crucial to the preparation and use of a wide array of industrially significant materials. Center researchers use advanced processing technology to develop new materials and then work with industrial partners to apply them to social and industrial needs.

• **Computational Fluid Dynamics Center**—John C. Tannehill, manager. The Computational Fluid Dynamics Center uses powerful computers to solve complex engineering design problems associated with liquids or gases in motion. This research has applications in aerospace and other industries; for example, significant funding from NASA has supported studies of flow fields around the space shuttle. The center also administers interdepartmental course offerings in computational fluid dynamics.

• **Electric Power Research Center**—Glenn Hillesland, interim director. The Electric Power Research Center promotes and expands research in electric power and energy-related fields, attracts students and faculty to the power engineering field, and develops seminars and short courses for professionals. The center is an umbrella for the Power Affiliates Program, an electric power research effort established in 1963; the Iowa Test and Evaluation Facility, a research and demonstration facility founded in 1979 near Fort Dodge; and the Power System Computer Service, a program for conducting load flow and fault studies for a power systems network covering Iowa and the surrounding area.

• **Iowa State University Industrial Assessment Center**—Richard Rusk, project director. This center provides energy audits to small and medium-sized manufacturing companies and recommends ways to reduce their energy consumption and become more profitable. ISU teams that include both professional researchers and students visit the site, collect data, conduct analyses, and write reports for each company.

Geographic Information Systems (GIS) Facility—Kevin Kane, manager. The GIS Support and Research Facility was established to support the use of GIS in research and education. It provides hardware and software platforms and technical services for researchers to use for GIS-related projects. The facility has seven Vincent workstations and a variety of input and output devices. It also provides support and periodic training for GIS software products. Software supported by the facility includes the ARC/INFO GIS software, ERDAS for image processing, and Oracle for relational data base management.

Industrial Relations Center—Paula C. Morrow, director. The central focus of research is on the behavior of individuals and organizations in an employment and labor force relationship. It provides an interdisciplinary approach to related studies.

Institute for International Cooperation in Animal Biologics—James Roth, Executive Director. In October 1995, the Iowa State University (ISU) of Science and Technology, the USDA Animal and Plant Health Inspection Service's (APHIS), National Veterinary Services Laboratories (NVSL), and the USDA Agriculture Research Service's (ARS), National Animal Disease Center (NADC) jointly formed the Institute for International Cooperation in Animal Biologics (IICAB). The overall goal of the IICAB is to improve the availability, safety, efficacy, and use of veterinary biologics (vaccines) throughout the world. The institute works with the veterinary biologics industry, government regulatory and research agencies, universities, veterinarians, and producers in an effort to improve the availability and use of biologics for animals worldwide. The IICAB objectives are to serve as an internationally recognized body that works to build consensus on policy issues, and that works for the establishment of international standards in animal biologics, and in harmonization efforts; to coordinate assistance for countries in receiving and/or manufacturing veterinary biologics to meet specific needs; to serve as an international resource center that conducts impartial testing, and assists in the development and supply of reagents and technology transfer; to implement cooperative research programs involving government, university and industry scientists to conduct basic research; and to develop new technologies for targeted diseases in specific regions of the world.

Institute for Physical Research and Technology—Thomas J. Barton, director. The institute consists of a federation of basic and applied research entities (primarily U.S. government and industrially funded). The coordination and unified planning provided by the institute result in a significant enhancement of the overall effectiveness of the enterprise and facilitate the achievement of the specific goals and objectives of its components. The laboratories and centers of the institute represent a major consortium for the pursuit of vital educational, research, technology transfer, and technology development thrusts of the university, state, and nation. These organizations include the following:

•**Airworthiness Assurance Center of Excellence**—William Shurtleff, director. The purpose of this center is to develop advanced technologies that will be a key factor in maintaining the U.S. leadership role in aviation safety and global competitiveness in aviation systems.

•**Ames Laboratory of the United States Department of Energy**—Thomas J. Barton, director. The laboratory staff conducts basic and intermediate-range applied investigations that seek to discover new scientific knowledge, improve understanding of natural laws and phenomena, and develop relevant technologies pertinent to energy production,

conversion, and transmission, as well as to other critically important national programs. The laboratory prepares scientists for work in the physical sciences, engineering, and energy-related fields through research appointments for Iowa State University graduate students and postdoctoral associates.

•**Center for Advanced Technology Development (CATD)**—Robert Harris, interim director. The Center for Advanced Technology Development is a research and business development organization for technology transfer. In this capacity it bridges the traditional gap between university basic research and industrial commercialization. The technical work performed by the center is predominantly applied research in the field of materials and related technologies. CATD broadly supports this type of research in other research and academic centers throughout the university.

•**Center for Coal and the Environment**—Robert C. Brown, interim director. This center was officially established to accept funds and direct the state-federal mineral resources research program of the U.S. Department of Interior. The focus of the program is to minimize the environmental impacts associated with the mining of coal and other mineral resources. This center's graduate education and research programs provide increased opportunities for regional research and education in the field of mining and mineral resources.

•**Center for Nondestructive Evaluation (CNDE)**—R. Bruce Thompson, director. The Center for Nondestructive Evaluation sponsors an interdisciplinary program that conducts fundamental and applied research leading to improved NDE technology. Research areas include ultrasonics, electromagnetic techniques, thermal wave imaging, microfocus x-ray techniques, artificial intelligence and expert systems with application to NDE measurements, signal processing routines, NDE of composites, NDE for material properties, and new instrumentations.

•**Center for Physical and Computational Mathematics**—Bruce Harmon, interim director. This center develops new mathematical tools and researches the application of computers to special problems.

•**Center for Rare-earths and Magnetics**—R. William McCallum, director. This center collects, disseminates, stores and evaluates rare-earth information from throughout the world.

Iowa Center for Emerging Manufacturing Technology (ICEMT)—James E. Bernard, director. The mission of the Iowa Center for Emerging Manufacturing Technology is to develop ways to improve manufacturing productivity and to transfer manufacturing related technology to industry. The center conducts interdisciplinary research that leads to improved manufacturing technology. Research is conducted in the areas of concurrent engineering, computer visualization, off-line programming, composites, computational geometry, design for manufacturability, surface geometry, acoustic diagnostics, and design optimization.

•**Materials Preparation Center**—Lawrence Jones, director. The purpose of this center is to support basic research and provide to researchers worldwide materials unavailable from domestic suppliers.

•**Microanalytical Instrumentation Center**—Marc Porter, interim director. This center addresses challenges presented by environments hostile to conventional analytical instrumentation and/or alien to experience.

•**Microelectronics Research Center**—David Lynch, director. The Microelectronics Research Center conducts mission-oriented basic and applied research on electronic materials, devices, and applications. The center works closely with academic departments to promote and support graduate education in electronic sciences.

International Institute of Theoretical and Applied Physics—James Vary, acting director. The purpose of this institute is to empower scientists of developing countries to carry out research and teaching in their own countries and thereby to help strengthen the science and technology infrastructure of their regions; and to foster collaborations between U.S. scientists and their colleagues throughout the world.

Iowa Energy Center—Floyd Barwig, director. The State of Iowa created the center in 1990 to support efforts to increase energy efficiency in all areas of Iowa energy use. The center is administered by Iowa State University, with input from an advisory council representing Iowa educational institutions, utilities, and state agencies. Competitive grants are awarded by the center to nonprofit organizations in Iowa, including universities. Research and demonstration projects supported by center grants focus on energy efficiency, assessment of energy-related technology, development of alternative energy systems based on renewable sources, and educational programs encouraging energy efficiency. Conferences and workshops are also supported through center grants.

Iowa Space Grant Consortium—William J. Byrd, director. The Iowa Space Grant Consortium is a collaborative effort of Iowa's three Regents institutions. To achieve its goal of statewide awareness of and participation in space science and engineering, it sponsors a number of activities such as the Iowa Satellite Project, a student-designed and operated small satellite gathering meteorological and soil condition data over Iowa. The consortium also offers graduate fellowships, undergraduate scholarships, and summer research opportunities for undergraduates.

National Soil Tilth Laboratory—Jerry L. Hatfield, director. The laboratory is a federal research facility administered by the Agricultural Research Service, U.S. Department of Agriculture, at Iowa State University. Activities involve research on the fundamentals and management of soil tilth to solve national problems such as maintaining water quality, enhancing soil quality, controlling soil erosion, and developing a profitable, sustainable agriculture. The laboratory has a scientific staff from the areas of agronomy,

soils, physics, chemistry, microbiology, agricultural engineering, and agricultural economics.

Statistical Laboratory—Dean L. Isaacson, director. This research and service institute conducts research in statistical theory and methodology. It promotes and fosters the use of sound statistical methods in university research through on-campus consulting. Similar consulting aid, research cooperation, and services are extended to off-campus groups, other colleges and universities, and government agencies when such activities are of mutual benefit or otherwise in the public interest.

Veterinary Diagnostic Laboratory—Gary D. Osweiler, director. The laboratory provides a research, teaching, and service facility to which the veterinary medical profession may bring animal health problems for counsel and diagnostic assistance. Disciplines utilized are pathology, bacteriology, virology, serology, chemistry, and toxicology. A graduate residency program for pathology, microbiology, and toxicology is active.

Water Resources Research Institute—Dennis Keeney, director. The institute coordinates and administers an interdisciplinary program in water resources research. It administers the research funds received from the U.S. Department of the Interior, as made available through the Water Resources Research Act of 1983, and from the State of Iowa. Funds received from private, state, and federal sources are allocated for research in all aspects of water resources, and are directed primarily at solving state, regional, and national water problems. Technology transfer and information dissemination are additional elements of the program.

College Research Institutes

Agriculture and Home Economics

Experiment Station—See description at the beginning of this section.

Business Research Institute (BRI)—Benjamin J. Allen, director. A component of the College of Business's mission is to create and disseminate knowledge and to offer innovative programs to prepare managers and leaders for a technologically oriented world. The BRI plays an important role in carrying out this mission. Through the institute, support is provided for applied research by college faculty and graduate students, resulting in the advancement of new knowledge for the business world. A concerted effort is made to encourage research within each of the college's departments.

Engineering Research Institute—James L. Melsa, director. The institute coordinates staff research in areas involving all engineering academic departments and maintains major laboratories and technical service groups to support the various research programs. Funds are derived from state appropriations and from industrial and government grants or contracts. Activity is directed toward graduate instruction, basic research, and applied research.

Family and Consumer Sciences Research Institute—Mary Winter, associate dean. The

focus of the institute is to improve the quality of life for individuals and families through basic and applied research. Graduate education, support of college research facilities, and staff support comprise the bulk of the remaining activities.

Institute for Design Research and Outreach—Mark C. Engelbrecht, director. The institute coordinates and facilitates research, artistic and creative design efforts of faculty and graduate students of the College of Design. It also coordinates the integrated outreach efforts of the college by providing a linkage between design extension and the research and instructional efforts of the college. The institute maintains the Design Simulation Laboratory, the Design GIS Laboratory, and the Architecture Technology Laboratory.

Research Institute for Studies in Education (RISE)—Walter Gmelch, dean and director. RISE provides leadership for and participates in research and contract and grant activities conducted by faculty, staff, and students of the College of Education. RISE promotes and conducts research that is directly related to the mission of the College of Education and Iowa State University of Science and Technology. RISE emphasizes efforts to secure external funding for research and development activities related to the mission of the college and the university. The institute provides linkage with other units on and off campus and facilitates collaborative research activities through financial and personnel support. To support its mission, RISE is organized administratively into two primary components: research, and contracts and grants.

Veterinary Medical Research Institute—Richard F. Ross, director. The institute is multidisciplinary with a responsibility to conduct research and offer research training in animal diseases. Research and research training are conducted in the areas of viral, bacterial and parasitic diseases, immunology and basic biology.

University Extension

ISU Extension supplies science-based education and information services to Iowa citizens. Extension also serves to engage Iowa State University with the people and organizations of Iowa, and those people and organizations representing Iowa interests nationally and internationally. Extension is the institution-wide mechanism through which ISU shares its research and educational capacities, and through which these programs are informed of the priorities and interests of Iowans.

ISU Extension also is part of a national network, including the U.S. Department of Agriculture, 104 land-grant institutions, and 3,150 county programs. ISU Extension has offices and staff in every Iowa county. These offices provide Iowans easy access to ISU and a local presence for the University. ISU Extension also partners with Iowa community colleges, the other Regents universities, and the private colleges and universities, providing an array of inter-institutional technical assistance, training and education programs.

ISU Extension serves Iowans and other clients in six program areas—Agriculture and Natural Resources, Business and Industry, Communities, Families, 4-H Youth Development, and Extended and Continuing Education. A description of the units follows.

Extension to Agriculture and Natural Resources

Agricultural programs serve primarily producers and agricultural support service industries statewide through education and service. Agricultural programs lead to increased profitability through enhanced management and marketing in an environmentally and socially acceptable system.

Extension to Business and Industry

Extension programs that assist business and industry firms are provided statewide through several cooperating organizations, including the College of Business, the College of Engineering, the Iowa Manufacturing Technology Center (IMTC), and the Center for Industrial Research and Service (CIRAS). Educational services are provided to contractors, consultants, manufacturers, the food service industry, and utilities to help maintain and increase profitability. IMTC provides consulting services to small and medium-sized manufacturers throughout the state.

Extension to Communities

ISU Extension to Communities helps organizations and local governments develop and build their capacity to make Iowa communities better places to live and work. The aim is to help Iowa communities analyze and understand their needs, identify alternative courses of action, make informed decisions, plan for the future, and evaluate their efforts.

Extension to Families

The Extension to Families unit provides education for families on: aging, child care, consumer decisions, family financial management, family relationships, housing choices, nutrition and health, parent education, and public policy affecting families.

Extension to 4-H Youth Development

This unit helps youth become self-directing and contributing members of society. 4-H youth programs teach through experiential learning, use prevention and early intervention approaches, and promote a sense of closeness between every youth and at least one significant adult. Subject matter is built on the knowledge base of ISU and other land-grant universities.

Extended and Continuing Education

As part of ISU Extension, the Extended and Continuing Education program supports ISU faculty and staff in developing and delivering off-campus credit programs and noncredit conferences and seminars to meet the lifelong learning needs of Iowans. These distance education programs are offered via the Iowa Communication Network (ICN), the World Wide Web, and through videotapes shipped directly to students. Extended and Continuing Education is working with the ISU colleges and extension field staff to explore the possibilities for expanding the use of existing degree programs and adding new distance education opportunities.

The Academic Advising Program

Iowa State University's academic advising program strives to enhance the student's intellectual and personal growth, to sharpen the student's decision-making skills, and to integrate the student's academic and future career plans.

Each student is assigned an adviser when he or she arrives on campus, usually a faculty member or professional adviser in the department in which the student is majoring. If a major has not yet been declared, a member of the college faculty or staff will be assigned as adviser. The adviser can serve as a primary resource for the wide variety of university support services available to Iowa State University students, but it is the student's responsibility to ask for assistance.

Advisers assist in the development of an academic program that meets students' career objectives as well as curriculum requirements. Advisers can help students achieve their academic objectives by advising them about course requirements, recommended electives, and procedures for registration and schedule changes. It is the student's responsibility, however, to be informed about the requirements for his or her degree and to ensure that these requirements are met. Advisers will however, help students to get the most out of their educational experience.

In most departments, students may change advisers if they wish, to do so, students should first obtain the agreement of another member of the department to become their adviser and then request permission from the department for the change they want to make. Students who wish to change advisers but do not know the professional emphases of the advisers in their department, or for any other reason are unable to obtain the services of an adviser, should ask their department or college office to assign them to an adviser.

Learning Communities

Learning communities are a university-wide initiative that provide new students with an opportunity to connect with peers who have similar academic goals. Advantages include seeing familiar faces in classes, making a smooth transition from high school to college by developing academic and social networks, developing links between in-class and out-of-class learning opportunities, communicating with instructors, and reducing scheduling conflicts by registering for a block of classes.

Students are offered the opportunity to join learning communities during freshman summer orientation. Learning community students take specific courses together, work with mentors (including faculty, staff and students),

create their own study groups and, in some cases, live on the same residence hall floor. Students are encouraged to make their requests for learning communities early, because space is limited.

ISU AccessPlus Information System

AccessPlus is a campus information system that is available via the World Wide Web or from various kiosks around campus. Advisers and students can use AccessPlus to view and verify information such as their current term schedules, meeting rooms, and instructor information. Also, students can use the system to view their academic record including their latest term grades, their financial aid status, and their current university bill. The system allows a student to review other personal information such as academic adviser assignment and date of graduation. Students may print information from AccessPlus for a nominal charge. AccessPlus may be found via the World Wide Web from www.public.iastate.edu/~registrar_info/access.html.

Enrollment in Courses

Responsibilities of the Student, Adviser, and College Classification Office Staff in the Registration Process

Registration at Iowa State University begins with a meeting with an academic adviser. The registration process includes advising, enrollment in courses, and schedule changes. This process involves the student, the student's adviser, and the classification staff of the student's college, each of whom is responsible for knowing and following the academic policies and procedures described here.

The student is responsible for knowing university policies and procedures with respect to registration and schedule changes, and for carrying out those procedures. The student is responsible for the accuracy of his or her schedule, including schedule adjustments (e.g., adds, drops, section changes). The student is also responsible for knowing the degree requirements of his or her major and/or curriculum, for planning course schedules to meet those requirements, and for monitoring the accuracy of the advisement/degree audit.

The adviser is responsible for being available to consult with advisees during the advising/registration period, for providing information about the requirements of the student's major and curriculum, for providing guidance in the student's selection of courses, for assisting the student in monitoring the accuracy of the advisement/degree audit, and for notifying the college classification office if corrections to the advisement/degree audit need to be made.

The college classification staff is responsible for assisting new and reentering students with the registration process, for resolving unusual scheduling problems, and for updating the advisement/degree audit.

The dean* is responsible for making decisions with respect to requests for deviations from university policies, deadlines, etc. Check with your college office to find out who is authorized to grant approvals or exceptions on behalf of the dean.

Registration

Registration and the payment of assessed fees are required of all who attend classes. Enrollment is not complete until all fees are paid, including board and room fees for those living in residence halls.

Once students are enrolled at Iowa State University, they will register each semester for the following semester as long as they continue to be students. Registration is a process by which students become officially enrolled in the university for a given term. It involves students selecting courses they wish to take in consultation with their adviser, enrolling in courses by means of touch-tone or walk-through registration, and making necessary schedule changes.

Registration takes place in the middle of the semester and lasts four weeks. Registration for summer session should be completed during the previous spring at the same time as registration for fall semester. The advising period begins three days prior to registration. Students must see their adviser before they may enroll in classes. Advisers will provide materials that students must have before their registration can be processed.

Dates for advising and registration are included in the University Calendar, the ISU Directory, the Schedule of Classes, and the Iowa State Daily, and are posted on departmental bulletin boards and the World Wide Web.

All students are encouraged to register for courses through the Touch-tone Registration System. If they are unable or choose not to register through the touch-tone system, a walk-through procedure is also provided. Students who do not register by the published deadline for initiation of a schedule through the touch-tone system may use the walk-through procedure to process their registration.

Students will be assigned a registration start date, which is the first day and time on which they may enroll in classes for the next term. The registration start date is included in the materials advisers provide. In general, registration start dates are assigned according to each student's projected year-in-school, based on the sum of total credits earned and current term credits. Students may choose to delay their registration until a later date, but courses

will begin to fill on the first day of registration and any delay may reduce chances of being scheduled into the courses they wish to take.

To register for classes, students will need the following materials:

1. A Touch-tone Registration Worksheet, which their advisers will provide.
2. A *Courses and Programs Bulletin*, available for a fee from campus area bookstores.
3. A Schedule of Classes, accessible from World Wide Web, available for use at the reserve desk of the Parks Library and in departmental and college offices, and available for purchase at campus area bookstores.
4. Other departmental information, which advisers can provide.

Steps in the advising/registration process students should follow are:

1. Meet with their adviser, who will:
 - a. give them their advisement/degree audit;
 - b. provide guidance in the selection of courses and alternatives;
 - c. sign their Touch-tone Registration Worksheet; and
 - d. give them their Registration Authorization Card. (Students whose adviser does not have a Registration Authorization Card for them may present their Touch-tone Registration Worksheet with their adviser's signature to the Registrar's Student Scheduling Office, 10 Alumni Hall, where a duplicate authorization form will be prepared for them.)
2. Choose specific sections of each course. Choice of sections is the student's responsibility, and in most cases advisers will not be involved in the selection of meeting times.
3. Review their Registration Authorization Card to find:
 - a. the first day and time when they may register;
 - b. their registration access number (printed on the Registration Access Card, a tear-off section of the authorization card);
 - c. any registration holds, which will delay their registration if not resolved;
 - d. the date on which their schedule will be mailed and the address to be used for that mailing;
 - e. fee assessment information, which they need to edit.
4. Enroll in courses through the Touch-tone Registration System. Instructions for registration through the touch-tone system are printed on the Touch-tone Registration Worksheet and detailed instructions are published in the Schedule of Classes.

In order to access the Touch-tone Registration System, students must use their student I.D. number in combination with the registration access number printed on their authorization form. Students will be held accountable for all changes made to their schedules through the Touch-tone Registration System. To ensure the security of their schedule, students should memorize or record their registration access number in a secure location and destroy the Registration Access Card portion of their authorization card. If students lose their registration access number, they may present their approved Touch-tone Registration Worksheet

at the Registrar's Student Scheduling Office, 10 Alumni Hall, to find out or change their current registration access number.

If students do not have access to a touch-tone telephone or for any other reason are not able to register through the touch-tone system, they may process their Touch-tone Registration Worksheet at the Registrar's Student Scheduling Office, 10 Alumni Hall.

If students have any holds on their registration, they will not be permitted to start registration until the holds have been released by the initiating offices. If students attempt to register before their holds have been released, the voice response will indicate which offices have placed holds on their registration.

As students enroll in classes through the Touch-tone system, there will be a voice response after each entry that indicates whether each request has been processed. As requests are processed, students should keep a record of the courses scheduled on their Touch-tone Registration Worksheet. When the touch-tone registration is complete, students will know which sections have been scheduled and the meeting days and times for all sections on their schedule. Students who lose their worksheets or need to review their schedules, may call to request a "list" action through the touch-tone system and their schedules will be read aloud. Students also may view their schedules on AccessPlus, which is available from www.iastate.edu and on the kiosks at several locations on campus.

Students who need to add courses or make other schedule changes may process their requests through the Touch-tone Registration System. The last day for schedule changes through the touch-tone system is the fifth day of classes.

Each student has a credit limit for registration. For fall and spring semesters, this limit is 18 credits for undergraduates and 15 credits for graduate students. For summer session, the limit is 12 credits for undergraduates and 10 credits for graduate students. If students attempt to add a course beyond their credit limit, their add request will be denied and they must drop credits before they may add. In some cases, the college may approve a higher or lower credit limit for individual students. If students need to request a change in their credit limit, they should contact their adviser. Advisers should notify the student's college classification office if the credit limit should be changed.

Some courses or sections are restricted to students who meet specified criteria including curriculum/major, college, and/or year in school. In addition, some sections may be restricted to new students to ensure that sufficient spaces are available when new students register during June orientation. If a student has extenuating circumstances and the department agrees to waive the restriction for a course, the student must obtain the designated departmental signature on a Schedule Change/Restriction Waiver form and process the form in the Registrar's Student Scheduling Office, 10 Alumni Hall. Some sections are designated in the *Schedule of Classes* as "Permission required." Students may not

enroll in these sections through the Touch-tone Registration System. To add such a section, students must obtain the instructor's signature on a Schedule Change/Restriction Waiver form and process the approved form in the Registrar's Student Scheduling Office, 10 Alumni Hall.

In some cases, sections may be canceled due to low enrollment or departmental staffing considerations. If students enroll in a section that is subsequently canceled, they will be notified by the Office of the Registrar, by the department, and/or on their printed schedule.

Disabled students who need assistance with any phase of registration should contact the Registrar's Student Scheduling Office, 10 Alumni Hall.

5. Participate in walk-through registration (applicable only to students who do not enroll in courses through the Touch-tone Registration System). The procedure for walk-through registration is the same as the touch-tone registration procedure described above, except for the use of the telephone to enroll in classes. Students using the walk-through registration process must present their Touch-tone Registration Worksheet with their adviser's signature to the Registrar's Student Scheduling Office, 10 Alumni Hall, where their schedule will be processed.

6. Students' schedules, data verification forms, and registration receipts will be mailed approximately one month before classes begin. It is the student's responsibility to review this information and contact the Office of the Registrar if there are any changes or corrections that need to be made.

Schedule changes processed before schedules are printed will be reflected on the printed copy of student schedules. Students who process changes after the date schedules are printed should note the changes on the printed copy of their schedules. A charge will be assessed for a replacement copy of the student data verification and schedule form. Changes in schedules also can be viewed using AccessPlus, available from www.iastate.edu, and on the kiosks at several locations on campus. After the schedule mailing date, meeting room locations can be obtained by requesting a list action on the touch-tone system or by accessing the online Schedule of Classes from the ISU web page.

All changes processed before the first day of classes will be reflected on beginning class lists so that instructors will be informed as to which students are officially registered as of the first day.

Payment of Fees

Students will be billed by the Receivables Office for tuition, room and board, and various other university charges. A statement of charges will be mailed on the first of each month to each student's in-session or interim address. Students also may view their account status on AccessPlus which is available from www.iastate.edu and on the kiosks at several locations on campus. It is the student's responsibility to ensure that the Office of the Registrar has a correct billing address. A student who does not receive a billing statement

before the term begins should go to the Receivables Office, 1 Beardshear, to learn the amount of the account balance due. *Failure to receive a billing statement will not exempt students from late penalties or from having a hold placed on their registration.* Also see *Index, Fees and Expenses.*

Additional Registration Regulations

A late registration fee is charged beginning on the first day of classes for the term. This fee is not charged for the summer term. Registration should be completed by the end of the fifth day of classes. To register after the fifth day of classes, students must obtain written permission from the instructors of the courses they plan to take, as well as approval of the dean* of the college in which they are registered. During the summer session, these approvals must be obtained in order to register after the third day of classes.

Registration for a given semester is closed after the tenth day of classes, and after the fifth day of classes for summer session.

Students may not enroll in courses with time conflicts without the approval of the departments concerned.

Students who participate in off-campus experiences for which they receive Iowa State credit must register for that credit during the term when the experience is taking place, even though they may be taking no courses on campus during that time.

Students may obtain academic credit for an activity, either on or off campus, for which they are also paid, provided that they engage in an academically relevant activity beyond that for which pay is received. Arrangements for receiving credit must be made with a faculty member in an appropriate department and must include agreement on (1) the academic objectives which the activity is expected to achieve, and (2) the procedure by which the student's learning will be assessed. This policy does not apply to registrations for R credit.

Validation of Enrollment

To validate their enrollment in each course at the beginning of the semester, students must attend the first or second meeting (first meeting if the class meets only once a week).

Students who add a course after the term begins must attend the next class meeting. The instructor has the option to offer a registered place in the course to another student when a registered student fails both to attend and to obtain prior approval of the instructor. However, those students will not be automatically dropped from the course; they must drop the course themselves or they will receive an F grade.

Making Schedule Changes

Procedures for schedule changes vary by the time period of the semester. The effective date of a schedule change is the date on which the change is entered into the registration system. Schedule change periods are as follows:

Period 1 ends on the fifth day of classes of the semester. Schedule changes during period 1 are free and do not require adviser signatures. Instructor or departmental approval may

be required for adds or section changes in some courses during period 1. Course drops during this period do not count toward a student's ISU course drop limit, and will not appear on a student's grade slip or permanent record. Schedule changes during period 1 may be processed through the Touch-tone Registration System or by presenting a Schedule Change/Restriction Waiver form to the Registrar's Student Scheduling Office, 10 Alumni Hall.

Period 2 ends the third Friday of classes after the day midterm grades are due. During this period, schedule changes require signatures of adviser and instructor and are processed on a Schedule Change/Restriction Waiver form. A \$5 fee per schedule change form is assessed for adds, drops, and section changes during this period. Course drops after period 1 count toward a student's ISU drop limit and appear as an X on the grade slip and permanent record.

Drops and other schedule changes that are judged to be beyond the student's control may be processed as administrative actions if approved as such by the college dean*. There is no \$5 fee for administrative schedule changes. Administrative drops do not count toward a student's ISU drop limit and do not appear as an X on the grade slip and permanent record. The effective date of an administrative action is the date it is approved by the college dean*.

Period 3 follows period 2 and extends through the remainder of the semester. Schedule changes during this period are permitted only for extenuating circumstances beyond the student's control, require a written statement of support from both the instructor and the adviser, and must be approved by the dean* of the student's college.

Specific deadlines for adding and dropping half-semester courses are published in the University Calendar. Appropriate adjustments to add and drop deadlines are made for other partial term courses. To find out specific deadlines for partial term courses, contact the Registrar's Student Scheduling Office, 10 Alumni Hall.

Drop Limit

Students are limited in the number of courses they may drop during their academic career. (This refers to drops processed after the fifth day of classes of each semester.) Students who entered Iowa State as freshmen are allowed to drop a maximum of five courses during their undergraduate career. If they entered at a level above freshman classification or in the College of Veterinary Medicine, they are allowed to drop a maximum of four courses. Courses dropped during their first term at Iowa State are not included in this

+For the 1999-2000 academic year, period 2 ends on October 29 for fall semester and on March 24 for spring semester. For the 2000-2001 academic year, period 2 ends on October 27 for fall semester and on March 23 for spring semester.

*Students should check with their college office to find out who is authorized to grant approvals or exceptions on behalf of the dean.

limit, nor does the summer count as a first term for this purpose. Students who enroll at Iowa State University as undergraduates after receiving a bachelor's degree are permitted two drops.

Exceptions may be made for courses that must be dropped for reasons beyond the student's control. These exceptions are granted only by the dean* of the student's college.

The number of drops students have left is indicated on their grade slip each term. Each student is responsible for not exceeding her or his limit. Students who attempt to drop a course beyond the limit without special permission of their dean* will continue to be enrolled in the course and will receive a grade at the end of the term.

Enforcement of Course Prerequisites

A prerequisite indicates the specific academic background or general academic maturity considered necessary for the student to be ready to undertake the course. Since an instructor has the prerogative to direct a student who lacks a stated prerequisite to drop the course, students are advised not to enroll in a course for which they lack a stated prerequisite without checking first with the course instructor. Permission of the instructor is understood to be an alternate to the stated prerequisites in all courses.

It is university policy that the instructor shall inform the students at the beginning of each course if students who have not met the prerequisite requirements must drop the course.

Course prerequisites are presented in the Schedule of Classes as well as in the Courses and Programs section of this publication.

Withdrawal and Reentry

Cancellation of Registration

Students who wish to cancel their registration must notify the Office of the Registrar before the first day of classes to avoid tuition assessment. Beginning with the first day of classes, students must formally withdraw from the university to terminate their registration. Tuition adjustments are made for withdrawals of registration according to the following schedule:

Withdrawal Date

for continuing students	Student Pays
First 8 class days	10%
Next 12 class days	50%
Next 20 class days	75%
After 40 th class day	100%

The following refund schedule for first-time enrolled recipients of Title IV financial aid will be calculated in accordance with PL 102-325, the Higher Education Amendments of 1992.

Withdrawal Date	Student Pays
First day of classes	0%
Days 2-5 of classes	10%
Weeks two and three	20%
Week four	30%
Weeks five and six	40%
Weeks seven and eight	50%
Week nine	60%
Week ten	70%
After week ten	100%

Students may cancel their registration by writing to the Office of the Registrar, 210 Alumni Hall, by going to that office in person, or by calling 515-294-1889. Students who call should request the name of the person taking the call and make a record of the name as well as the time and date called. A letter of confirmation will be sent after notification is received by the Office of the Registrar.

To appeal the tuition adjustment students receive, they should contact the fees section of the Office of the Registrar. Cases will be considered based on extenuating circumstances beyond the control of students. To appeal the decision of the Office of the Registrar, students must make their request for appeal within 10 calendar days after receiving the decision of the Office of the Registrar. Their appeal will then be reviewed by the Tuition Appeals Review Committee. Students who wish to appeal the decision of the Tuition Appeals Review Committee may make a request to do so in writing to the Office of the Provost. Tuition appeals forms are available from the Fees Section of the Office of the Registrar.

Student-Initiated Withdrawal

Should it become necessary to leave the university before the end of a term, students should follow the procedures described in this section. Otherwise, students' records may be adversely affected and reentry or transfer to another institution may be difficult.

Students who are considering withdrawal from school should first consult their academic adviser at the earliest opportunity. The adviser may be able to suggest alternatives that will be more advantageous.

A request for withdrawal during period 3, (i.e., after the last day to drop a course without extenuating circumstances) will not be approved except for circumstances that are beyond the student's control. Such requests must be approved by the dean of the student's college. Students should check with their college office to find out who is authorized to grant approvals or exceptions on behalf of the dean.

Students should not expect to withdraw during or after the final examination week. In a situation beyond a student's control, when examinations cannot be completed, arrangements should be made for incompletes rather than withdrawal during final exam week. Students who are on temporary enrollment and withdraw during period 3 will not be permitted to enroll the following term, except under extenuating circumstances.

To withdraw from the university, students should:

1. Complete a Request for Withdrawal form and have their adviser sign it.
2. Request the approval and obtain the signature of the college in which they are enrolled. If approved, the withdrawal form will be forwarded to the Office of the Registrar where it will be recorded and the information sent to the appropriate offices.

The effective date of the withdrawal is the date on which it is approved by the college dean. Students should check with their college office to find out who is authorized to grant approvals or exceptions on behalf of the dean.

If students complete the withdrawal procedure, the courses they are taking will not be included on their permanent record nor will they be counted as part of their drop allowance. Half-semester courses completed prior to withdrawal will be included on their permanent record. Incompletes will not be accepted for withdrawals.

If these procedures for withdrawing from the university are not followed, the instructors of the courses involved will assign whatever grades or marks they consider appropriate. Since these grades may be F's, students are warned that failure to follow the prescribed withdrawal procedures may adversely affect a later application for reentry or transfer to another institution.

University-Initiated Withdrawal

In addition to the above procedures, exceptional circumstances may arise in which the university may initiate the withdrawal of a student. These include:

1. Extreme medical situations where the student is hospitalized and/or otherwise unable to implement the withdrawal process. Withdrawal is usually initiated by the academic adviser or the office of the college dean*.
2. Behavioral situations where it is determined that the student should not remain at the university due to behavior that demonstrates that the student is a clear and present danger to self or others. In these circumstances, it is the duty of the university to take responsible action for the good of the student and/or others in the university community.

Determination of the existence of exceptional circumstances that justify university-initiated withdrawal of a student for behavioral reasons will be made by the dean of students, the director of the Student Counseling Service, the director of the Student Health Center (or their designated agents) and appropriate academic representative, in consultation with the student, if possible. These persons may receive and/or solicit information, professional evaluation, etc., concerning the student's status. In the event that they concur that the student should leave the university, the student (and, in appropriate situations, next of kin) is to be informed in writing of the decision with recommendations concerning treatment or therapy, and the conditions required for consideration for readmission. This letter will be sent by the dean of students, who will also coordinate the review by the same panel.

When the decision has been made to withdraw a student, the student's adviser will be notified and requested to process the withdrawal form. The Dean of Students Office will place a "hold" on the student's records to prevent registration until a readmission decision has been reached by the behavioral review team.

Refund of Room and Board Fees

Refund of the unused portion of the contract is based on the daily rate of the remaining room and board fee. If fees have been paid, a refund will be authorized. If fees have not been paid, a charge will be made for the used portion of the contract. A refund is not authorized for any student leaving the residence halls after December 1 in fall semester or May 1 in spring semester.

Any student living off campus who has contracted for the meal plan to eat in a residence hall dining room and later terminates the contract will be refunded the same as above.

Returning or Reentry to the University

Returning

American undergraduate and nondegree undergraduate students planning to return to Iowa State University after an absence of less than twelve months do not have to complete a reentry form. International undergraduate and nondegree undergraduate students planning to return to Iowa State University after an absence of less than twelve months do have to complete a reentry form.

When they make the decision to return to ISU, American students should contact the Office of the Registrar to have their records updated.

Returning students who want to change their curricula should follow the same procedure as in-school students. Students who were dropped from enrollment at Iowa State must obtain reinstatement by the Academic Standards Committee of the college that initiated the drop. (See below for policies that apply to requests for reinstatement.)

Reentry

Undergraduate and non-degree undergraduate [special] students planning to return to Iowa State University after an absence of twelve months or more must complete a reentry form. Students with a bachelor's degree who wish to take supporting graduate-level coursework prior to applying for graduate degree admission should not complete this form, but should request an application for non-degree graduate admission. Students who have previously attended Iowa State only as non-degree [special] students and who now seek to earn an undergraduate degree should request an undergraduate application instead of this form.

The reentry form should be completed and returned to the Office of the Registrar well in advance of the opening of the term for which reentry is desired. Students who have attended another college or university since their last enrollment at Iowa State must have an official transcript(s) of all course work attempted sent to the Office of Admissions, 100 Alumni Hall. Reentering students must also contact their departmental office/adviser concerning preparation of a schedule. Approval of the reentry form is required prior to registration for classes.

International students should contact the Office of Admissions, 100 Alumni Hall (direct 515-294-5836 or toll-free 1-800-262-3810) for reentry instructions. Financial certification of ability to cover all educational and living expenses will be required.

Iowa State University requests the information on the form for the purpose of making a reentry decision. If the required information is not provided, the university may not consider the request to reenter.

Generally, a request to reenter Iowa State will be approved within the Office of the Registrar. However, the Office of the Registrar will refer the reentry form to the college to which a student plans to return if the student: (a) desires to change curriculum; (b) has a previous Iowa State University cumulative grade point average below 2.00 or had a last term average below 2.00; (c) was dropped from the university for unsatisfactory academic progress or was not otherwise in good standing; or (d) since leaving Iowa State, has completed additional college study with less than a 2.00 grade point average.

Students who have been dropped from enrollment at Iowa State must obtain reinstatement by the Academic Standards Committee of the college into which they wish to return. The following policies apply:

1. Students may not be reinstated until at least one term has elapsed since they were academically dismissed. The summer session is not considered as one term out of school.
2. A student who has been dismissed from enrollment two or more times is not eligible for reinstatement until at least two academic semesters have elapsed since his or her last academic dismissal.
3. Students who have been dismissed by a college and subsequently reinstated by another college cannot transfer back unless the Academic Standards Committee of the original college grants permission. This procedure must be followed regardless of the student's current academic standing.
4. Students must submit a petition to the Academic Standards Committee of the college in which they wish to enroll at least 45 days before the beginning of the term. This need not be the college from which the student was dismissed. (Students who have been dropped twice and wish to return in the College of Liberal Arts and Sciences must submit their petition at least 70 days before the beginning of the term.)
5. Reinstated students will return on temporary enrollment status.

Graduate students do not need to complete a reentry form to return to ISU. They should contact the Office of the Registrar to have their records updated and registration access created for them. Graduate students should contact their major professor to select courses and begin the registration process.

Academic Renewal Policy

Students who are returning to Iowa State University to pursue an undergraduate degree after an extended absence may request permission to remove one or more of their complete academic terms from future degree and GPA considerations. See *Index, Academic Renewal Policy*.

Academic Regulations

Class Attendance

Students are expected to attend all class meetings as scheduled. Each instructor sets his or her own policy with respect to class attendance, and excuses for absence from class are handled between students and the instructor. The instructor is expected to announce his or her policy at the beginning of the course. Please see section titled *Validation of Enrollment* on page 39 for regulations concerning attendance to validate students' enrollment in a class.

In order to attend a given class, a student must be registered for that class for credit or audit. Exceptions to this policy are at the discretion of the instructor of the course.

Veteran Attendance

Students receiving benefits from the Veterans Administration are identified on class lists and are required by the V.A. to attend class regularly to maintain their V.A. eligibility. If the instructor knows that a student receiving V.A. benefits is not attending class, the instructor is obligated to notify the Office of the Registrar and a notification will be forwarded to the Veterans Administration.

Field Trips

Trips away from campus are sometimes arranged as a means of enriching the students' learning experience in a given course. Such trips may not take place during the first or last week of the semester, nor may they extend over more than two consecutive class days (Monday through Friday); these regulations may be waived only by special permission of the dean of the college in which the course is offered. Students should check with their college office to find out who is authorized to grant approvals or exceptions on behalf of the dean.

In order to go on a field trip, students must first obtain permission from the instructors whose classes they will miss. If permission to miss class is not granted, students cannot be required to go on the field trip nor can they be penalized for missing the trip.

Special fees are often charged to cover the costs of field trips. Field trip fees are noted in the course description elsewhere in this catalog, and in the *Schedule of Classes*.

Ownership of Course-related Presentations

Course-related presentations, including lectures, are owned by the presenter. Individuals may take written notes or make other recordings of the presentations for educational purposes, but specific written permission to sell the notes or recordings must be obtained from the presenter.

Recording and Transmission of Classes

Recordings and transmission of classes may take place for a variety of legitimate reasons, including providing educational opportunities for those who cannot attend classes on campus, assisting students with disabilities that impair classroom notetaking, and giving the instructor feedback on his or her classroom performance.

Because the lectures of faculty represent their intellectual labors, individuals are expected to request permission to make recordings of lectures and other classroom interactions.

To the extent possible, the classes that are expected to be recorded or transmitted by the university are identified in the *Schedule of Classes*. Recordings may be used for the purposes of the particular class, although in some cases the recordings may be preserved and used for other classes as well.

Credit Involving a Paid Activity

Students may obtain credit for an activity, for which they are also paid, provided the activity is academically relevant. In order for an activity to be defined as academically relevant, prior arrangements for receiving credit must be made with a faculty member in an appropriate department and must include agreement on (1) the academic objectives which the activity is expected to achieve, and (2) the procedure by which the student's learning will be assessed. This policy does not apply to registrations for R credit.

Academic Dishonesty

Academic dishonesty occurs when a student uses or attempts to use unauthorized information in the taking of an exam; or submits as his or her own work themes, reports, drawings, laboratory notes, or other products prepared by another person; or knowingly assists another student in such acts. Such behavior is abhorrent to the university, and students found guilty of academic dishonesty face suspension, conduct probation, or reprimand. Instances of academic dishonesty ultimately affect all students and the entire university community by degrading the value of diplomas when some are obtained dishonestly, and by lowering the grades of students working honestly.

Examples of specific acts of academic dishonesty include but are not limited to:

Obtaining unauthorized information.

Information is obtained dishonestly, for example, by copying graded homework assignments from another student, by working with another student on a take-home test or homework when not specifically permitted to do so by the instructor, or by looking at one's notes or other written work during an examination when not specifically permitted to do so.

Tendering of information. Students may not give or sell their work to another person who plans to submit it as his or her own. This includes giving their work to another student to be copied, giving someone answers to exam questions during the exam, taking an exam and discussing its contents with students who will be taking the same exam, or giving or selling a term paper to another student.

Misrepresentation. Students misrepresent their work by handing in the work of someone else, for example, by purchasing a paper from a term paper service, by reproducing another person's paper (even with modifications) and submitting it as their own, by having another student do their computer program, or by having someone else take an exam for them.

Bribery. Offering money or any item or service to a faculty member or any other person to gain academic advantage for oneself or another is dishonest.

Plagiarism. Unacknowledged use of the information, ideas, or phrasing of other writers is an offense comparable with theft and fraud, and it is so recognized by the copyright and patent laws. Literary offenses of this kind are known as plagiarism.

One is guilty of plagiarism when one quotes the exact words of another writer without using quotation marks and indicating the source of the words, when one summarizes or paraphrases the words of another writer without giving the credit that is due, or when one borrows ideas from another writer without properly documenting their source.

Acknowledging the sources of borrowed material is a simple, straightforward procedure that will strengthen the paper and assure the integrity of the writer. *The English 104-105 Student Manual* provides guidelines to aid students in documenting material borrowed from other sources, as does almost every handbook in writing style.

Academic dishonesty is considered to be a violation of the behavior expected of a student in an academic setting as well as a student conduct violation. A student found guilty of academic dishonesty is therefore subject to appropriate academic penalty, to be determined by the instructor of the course, as well as to penalty under the university student conduct regulations.

If an instructor believes that a student has behaved dishonestly in a course, these steps are to be followed:

1. The instructor should confront the student with the charge of dishonesty and arrange a meeting with the student to discuss the charge and to hear the student's explanation.

2. **If the student admits guilt**, the instructor shall inform the student (a) of the grade on the work in which the dishonesty occurred, and (b) how this incident will affect subsequent evaluation and the final grade. Because academic dishonesty is also a student conduct violation, **the instructor must report the incident in writing to the dean of students.** The latter, or his/her designee, will meet with the student and, depending on the severity of the offense as well as on the student's past conduct record, may schedule a hearing before the All-University Judiciary Committee. This hearing, conducted according to the procedures outlined in the *Student Information Handbook*, is to determine the disciplinary action to be taken. In any case, the student's academic adviser will be informed of the incident but may not insert any record of it in the student's academic file.

3. **If the student claims to be innocent** of the charge, the instructor may not assign the student a grade for the work in question until the question of guilt is resolved, unless circumstances require that an interim grade be assigned. **The instructor shall consult with his or her department chair and report the incident in writing to the dean of students.** The latter will schedule a hearing before the All-University Judiciary Committee, to be conducted according to the procedures outlined in the *Student Information Handbook*. Both the student and instructor will be invited to attend the hearing and present pertinent information. If the student concurs, his or her academic adviser will be informed of the charge. If the Judiciary Committee finds the student guilty of the charge, the instructor will inform the student (a) of the grade on the work in which the dishonesty occurred, and (b) how this incident will affect subsequent evaluation and the final grade. The Judiciary Committee will determine the appropriate disciplinary action with respect to the student conduct violation. If the Judiciary Committee finds the student not guilty, the instructor will grade the student accordingly on the work in question and the student's grade in the course will not be adversely affected. If the student is found guilty, the student's adviser will be informed of the decision but shall not insert any record of the action in the student's academic file.

4. If a student either admits dishonest behavior or is found guilty of academic dishonesty by the All-University Judiciary Committee, the committee may impose any of the following sanctions:

Disciplinary Reprimand—An official written notice to the student that his/her conduct is in violation of university rules and regulations.

Conduct Probation—A more severe sanction than a disciplinary reprimand, to include a period of review and observation during which the student must demonstrate the ability to comply with university rules, regulations, and other requirements stipulated for the probation period.

Suspension Deferred—The suspension is deferred subject to a definite or indefinite period of observation and review. If a student is found guilty of further violation of the University Code of Conduct or an order of a judiciary body, suspension will take place immediately.

Defined Length—The student is dropped from the university for a specific length of time. This suspension cannot be for less than the remainder of the semester in progress or for the next full semester.

Indefinite—The student is dropped from the university indefinitely. To be reinstated the student must appear at a hearing conducted by the All-University Judiciary Committee, which makes the reinstatement decision.

Reinstatement may be contingent upon meeting written requirements specified by the All-University Judiciary Committee at the time of the reinstatement hearing.

5. A student accused of cheating has the option to stay in the class or to drop the class if the drop is made within the approved time periods and according to the regulations established by the university. If the student chooses to drop the class the student will be required to sign a statement of understanding that if the student is later found guilty of cheating, then the student will receive an "F" for the course.

6. Procedures for appeal of either the All-University Judiciary Committee's conduct decision or the instructor's grade are outlined in the *Student Information Handbook*.

7. In instances in which the student admits guilt or is judged to be guilty by the Judiciary Committee, a staff member of the Dean of Students Office will counsel with the student in an effort to deter any further such incidents.

8. Student records concerning academic dishonesty are maintained in the Dean of Students Office for a period of four years, after which the file records are purged. These student records are confidential; nothing from them appears on a student's academic transcript.

9. In the event that an instructor is uncertain how to handle an incident of suspected academic dishonesty, the dean of students is available at any time to provide advice and assistance to the instructor in deciding a proper course of action to be taken.

10. Students enrolled in the College of Veterinary Medicine are bound by an honor code. A charge of academic dishonesty may be made by a student or instructor to the Interclass Honor Board chairperson according to the procedures outlined in the Honor Code, or the instructor may follow the procedures outlined above. The Interclass Honor Board functions as the judiciary of the College of Veterinary Medicine for all allegations presented to it.

Progressing Toward a Degree

Classification

One indication that a student is making progress toward a degree is the change in her or his classification as a student. Classification is determined by the number of credits completed and reported to the registrar prior to the beginning of the term and is based on credit hours earned, not merely hours attempted. The grades of F and NP and the marks of I and X do not count in this classification system.

Classification in all colleges except Veterinary Medicine is uniform:

Sophomore classification—30 credit hours earned;

Junior classification—60 credit hours earned;

Senior classification—90 credit hours earned.

Students who have a bachelor's degree and are working toward another undergraduate degree, licensure, or admission to a specific graduate or professional program, may be classified as a senior.

Transfer students without a degree are classified on the basis of credits accepted by Iowa State.

A student who is attending Iowa State but does not wish to work toward an undergraduate degree will be classified as a special student. Admission requirements and academic standards regulations are the same as for regular students. Credits taken as a special student are applicable for undergraduate degree purposes if the student is later admitted as a regular undergraduate. Credits obtained as a special student may not, however, be applied toward a graduate degree.

Students enrolled in the Intensive English and Orientation Program (IEOP) are classified as special students in the College of Liberal Arts and Sciences and usually are not permitted to enroll in academic courses until they have satisfied requirements for admission as regular students. Permission to enroll in one academic course may be granted under special circumstances.

Promotion of veterinary medicine students from the first- to the second-, third-, and fourth-year classes is based upon satisfactory completion of the required courses for each year. To be promoted to the second-year class, students must have a cumulative grade-point average of at least 1.67 for all courses in the first year of the veterinary medicine curriculum. To be promoted to the third- and fourth-year classes, students must have a cumulative grade point average of at least 2.00 for all courses in the professional curriculum.

Transfer of Credits

Credits presented from another institution are evaluated initially by the Office of Admissions to determine whether the courses in which they were earned are acceptable for transfer credit. The application of those credits toward a degree will be determined by the student's college, based on their relevance to the requirements of her or his program as well as the level of performance deemed necessary for successful progress in that program. This means that courses that are deemed important to a program but in which credits were earned with less than a C grade may or may not be approved for application in a program, a policy that also applies to students already enrolled at Iowa State. Grades earned in courses transferred to Iowa State University will not be used in calculating a transfer student's Iowa State cumulative grade point average.

A student who is admitted as a transfer from another college or university is required to have at least a 2.00 cumulative grade-point average for all transferable work taken elsewhere. If, due to special circumstances, a student is admitted with less than a 2.00 average, that student has a transfer quality-point deficiency. This deficiency will be added to any deficiency accumulated at Iowa State University and will be used to determine whether satisfactory progress toward a degree is being made. To graduate, students must earn sufficient quality points above a 2.00 at Iowa State to offset any deficiency at time of entrance.

Students should consult with their academic advisers and the Office of Admissions before taking coursework at other colleges and universities to be certain it will be applicable to their program of study. Students who believe that any transfer credits have not been correctly evaluated should consult with their academic adviser and with the Office of Admissions. Questions concerning the application of transfer credits to the degree program should be referred to the academic adviser and college office.

No more than 65 semester or 97 quarter credits earned at two-year colleges can be applied to a bachelor's degree from Iowa State University. While there is no limit to the number of credits that may be transferred from a four-year institution, the last 32 semester credits must be completed at Iowa State.

Iowa State University students who attend one of the other Iowa Regent universities under the Regent Universities Student Exchange Program will have the credits earned at the other university counted as resident credit and grades received included in their Iowa State University cumulative grade point average. See *Index* for information on applying to the *Regent Universities Student Exchange Program*.

Degree Planning

In addition to being properly registered, students are responsible for knowing the requirements for the degree they hope to obtain and for planning their schedule to meet those requirements. Each college has a procedure to determine whether a student will fulfill all degree requirements for graduation.

Each fall and spring semester students receive an advisement/degree audit printout at the time of registration. This printout shows in a degree program format those courses that have been completed and those courses in which the student is currently enrolled. Also shown are the graduation requirements that have not been completed.

Students should use the information on this printout to help them select courses for the next term and to evaluate their progress toward their degree. If students have questions about how courses they have completed fulfill degree requirements or how courses they plan to take will apply to their degree requirements, they should discuss these questions with their adviser. During the term students graduate, a printout of this type will be used by the graduation evaluators in the Office of the Registrar to evaluate their graduation status.

Two Bachelor's Degrees

Students may receive two bachelor's degrees if the requirements for each major (curriculum) are met and the total number of semester credits earned is at least 30 more than the requirements of the curriculum requiring the greater number of credits. The same rule applies to degrees that are not awarded at the same time. Students should have an academic adviser in each major (curriculum), with one adviser being designated as the registration adviser. Students should request approval to

pursue two degrees by completing the form, Request for Double Major/Curriculum or Two Degrees. This form is available from advisers and classification offices. Each adviser will receive grade reports and schedule information after this form has been processed. Each degree program must be approved by the appropriate department and college.

Double Major/Curriculum

A double major is a program for a single degree in which all requirements for two or more majors (curricula) have been met. The majors (curricula) may be in different colleges or within the same college or department. The diploma and permanent record will designate all majors (curricula) that are completed at the same time.

Declaration of a double major (curriculum) should be made by completing the form, Request for a Double Major/Curriculum or Two Degrees. This form, available from advisers and classification offices, should be completed no later than the beginning of the senior year. One major (curriculum) should be designated as primary and the other secondary for purposes of record keeping, but the student's rights and responsibilities are the same in both majors. The adviser of the primary major will serve as the student's registration adviser, but both advisers will receive grade reports and schedule information. Degree programs must be approved for each major (curriculum) by the appropriate department and college. One of the majors may subsequently be canceled using the same form.

In addition to their engineering degree, students in the College of Engineering may earn majors in other colleges of the university. A major must meet all requirements of the offering department or program and its college and contain a minimum of 15 additional credits beyond the requirements for a B.S. degree in engineering for each major area of study. Within the College of Engineering, only double degrees are permitted.

Students with a primary major in another college who wish to take a second major in the College of Liberal Arts and Sciences are not required to meet the Liberal Arts and Sciences General Education requirements. They must, however, meet all requirements for the major, including complementary courses. Students in the B.L.S. curriculum in the College of Liberal Arts and Sciences do not have majors.

Second Major (Curriculum) Completed After the Bachelor's Degree

After receiving a bachelor's degree, a person may wish to complete all requirements for another major (curriculum). Approval of the department of the second major (curriculum) is needed before study for the program is begun. At the completion of the program a notation will be made on the permanent record (transcript), but no change will be made on the diploma received at the time of graduation. A degree program must be approved for the second major/curriculum by the department and by the dean's office.

Changing Curriculum or Major

A student's freedom to change her or his major, and the procedure that should be followed, depend on the student's academic standing as well as on policies of individual colleges as approved by the provost.

1. If students are not on temporary enrollment and have never been dismissed and reinstated, they may change their major by consulting first with their adviser. (If, however, they have been on temporary enrollment in the past, they may also be subject to regulation 4, below.) Beyond that, they should follow these procedures:

- a. If the change involves majors within the same college, they should check with the college office to obtain instructions as to how to make the change.
- b. If the change involves majors in different colleges, they should obtain a Change of Curriculum/Major form and their file from their adviser, present these materials to the classification office of their present college, then to the classification office of the college to which they are transferring, and finally to the office of their new major.

2. If they are on temporary enrollment, students must first obtain permission to enter the new major from the dean of the college responsible for that major in consultation with the department head. If they receive permission, they should then follow the procedures described above. If they are on temporary enrollment and want to transfer to another college in the university, they must do so before the last day to drop a course in period 2 (see page 39).

3. If they have been reinstated they may not transfer to another college during the first term following reinstatement, and they may not at any time transfer back to the college that originally dismissed them without the permission of the academic standards committee of that college.

4. If they transferred from one college to another while on temporary enrollment, they may not transfer back unless they have the permission of the academic standards committee of the college from which they originally transferred.

Declaring a Minor

Requirements for an undergraduate minor are specified by many departments and programs in the university; a record of completion of such requirements appears on students' transcripts. All minors require at least 15 credits, including at least 6 credits in courses numbered 300 or above taken at Iowa State. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement. Courses taken for a minor may not be taken on a pass-not pass basis. For additional information regarding policies which govern minors, see page 54. To declare a minor, students must submit a completed Request for a Minor form to their college office at least one term before graduation. The minor may be from the catalog the student is graduating under or a later catalog.

Graduation

Seniors must file a graduation application with the Graduation Office, 10A Alumni Hall, by the Friday of the first week of classes for students who plan to graduate in fall and spring semesters, and the last day of spring semester for students who plan to graduate in summer.

Applications may be obtained from the adviser; college office; for download from www.~registrar_info; the Student Answer Center, on the ground floor of Beardshear; or the Graduation Office, 10A Alumni Hall. Students will be notified by mail approximately four weeks after the semester begins of their graduation status.

Individual college ceremonies take place at the end of fall and spring semesters. The formal commencement ceremony for graduate students takes place on the Friday at the end of the semester, and the undergraduate ceremony takes place on Saturday. A combined undergraduate and graduate college commencement ceremony takes place at the end of the summer term.

Final grade checks will be made approximately two weeks after the end of the semester and diplomas will be mailed to all successful degree candidates.

In order to graduate, students must be certain:

1. Registration for the term has been completed and their date of graduation is correct on their advisement/degree audit printout.

2. They will have earned sufficient credits, acceptable toward graduation, to meet the minimum requirements for their curriculum. (Some examples of credit not acceptable toward graduation are: elective credits beyond those allowed in a curriculum, credits earned in passing the same course more than once, more than four credits of Athletics 101, and credit in two courses for which the catalog states that only one may count toward graduation.)

3. They have been certified by their major department as having achieved an adequate level of proficiency in written communication.

4. They have attained a cumulative grade point average of at least 2.00 in all work taken at Iowa State and have also met any special grade point averages required by their college, department, or program in specified groups of courses.

a. If they were admitted from another college or university with a quality-point deficiency, they must have earned sufficient quality points above a 2.00 at Iowa State to offset the deficiency with which they entered.

b. If they have taken work at another college or university prior to or after having been a student at Iowa State, they must have submitted a transcript of all such college study attempted to the Office of Admissions. This work must average 2.00 or the deficiency of quality points will be assessed against them. Failure to submit such a transcript is grounds for dismissal.

5. Incompletes in courses required for graduation have been removed by midterm of the term of graduation.

6. At least 32 credits have been earned in residence at Iowa State University, and the final

32 credits were taken at Iowa State. (Six of the last 32 credits may be transferred to Iowa State, with prior written permission of their major department.) A transcript of their transfer work must be received by Iowa State by midterm of the term of graduation.

7. They have paid all outstanding financial obligations they owe the university. If they owe an outstanding obligation to the university, a hold will be placed on their records and they will not receive their diploma or transcript. If students have questions about this policy, they should contact the graduation section of the Office of the Registrar, 10A Alumni Hall.

Evaluation of Academic Progress

Evaluation Procedures

It is university policy that the instructor shall inform the students at the beginning of each course of the evaluation procedures planned for use in the course.

Retention of Records

Records of all graded work must be retained by the instructors until midterm of the semester following completion of a course or until all pending appeals and incompletes are resolved, whichever is later. Instructors leaving the university must file test and grade records with their department office before departure.

Examinations

Examinations are one of the major means by which an instructor assesses students' performance in a course. In order that examinations can be a useful part of the educational process, the following policies have been instituted:

1. One purpose of examinations is to help students' learning activity. Therefore, examinations shall be evaluated as soon as possible after they are given and the results shall be made available to the students.

2. All tests and examinations administered between the beginning of the term and final examination week shall be held during a regularly scheduled lecture or laboratory class period for that course. A department may request permission to administer a separately scheduled examination if all of the following criteria are met: (a) the course is multi-sectioned; (b) a common departmentally developed examination will be administered to all students in all sections at the same time; and (c) the test scores will be used as a basis for a uniform grading procedure for all sections of the course. Requests to hold separately scheduled examinations must be made to the registrar and approved by the provost in time to be announced in the *Schedule of Classes*. Whenever a separately scheduled examination is administered, a regular class meeting during that week shall be omitted. Students who are unable to take a separately scheduled examination at the scheduled time because of a course conflict or other legitimate reason must notify the instructor in advance and must be given the opportunity to be examined at another time mutually convenient for the student and the instructor; the instructor shall determine whether to administer the same

examination or an alternate examination, or use an alternate assessment procedure.

3. At the end of the semester, a week is set aside for final examinations or other term evaluations, with a period normally of two hours scheduled for each course. The following policies govern the responsibilities of students and faculty members during this week:

a. Final exams in courses of two or more credits may not be given at a time other than that for which the exam is scheduled by the registrar. An instructor may not give a final exam prior to final exam week nor change the time of offering of the final examination as it appears in the final exam schedule. Permission to change the time for which an exam is scheduled may be given only by the dean of the college. If the instructor elects not to give a final exam, the class is required to meet at the scheduled final exam period for other educational activity such as a review of the course or feedback on previous exams.

b. Final exam periods are determined according to the regularly scheduled meeting time of the class. However, certain courses are assigned special group exam times so that several sections of the same course may be tested together. If this results in conflicting group examination periods, students should inform the instructor in charge of the first of the two conflicting courses as listed on the final exam schedule within the special groups in question; that instructor is responsible for arranging a special examination or making some other adjustment.

c. The final exam for a class that regularly meets in the evening must be held at the time the class would normally meet during the final exam week. If this exam conflicts with an evening group exam, the instructor responsible for the latter must arrange a special examination for any students who have a conflict.

d. If unusual circumstances involve the need for students to change the time of their final examination, they must obtain the approval of the instructor of the course.

e. If a student has three examinations scheduled on the same calendar day and wishes to change one to another day, the instructor of the course having the smallest number of students is responsible for arranging an alternate examination time for the student unless make-up exam times are available in one of the other courses.

f. All faculty members are considered to be on duty throughout the entire final examination week and are expected to be available to students during that week for discussion of any matters pertaining to the final examination and final grade or to other aspects of the course.

g. **Dead Week.** The last week of classes has been designated Dead Week by the Government of the Student Body. The intent is to provide students with time for review and preparation for final examinations. Therefore, no activities sponsored by student organizations under the jurisdiction of GSB may be held during that week. For academic programs, however, the last week of classes is considered to be a normal week in the semester. Instructors are reminded that

most students are enrolled in several courses each semester and their workloads often increase as final examination week approaches. Instructors are encouraged to give major assignments and examinations prior to the last week of classes so students can budget their time better for final examination preparation.

The Grading System

Grades represent the permanent official record of a student's academic performance. The grading system at Iowa State operates according to the following regulations:

1. Student performance or status is recorded by the grades and marks described below. A student's grade point average is calculated on the basis of credits earned at Iowa State with the grades and quality points shown below. Credits earned with P, S, or T are not used in calculating the grade point average but may be applied toward meeting degree requirements. A cumulative grade point average of 2.00 is required for a bachelor's degree.

Grades	Quality Points
A	4.00
A-	3.67
B+	3.33
B	3.00
B-	2.67
C+	2.33
C	2.00
C-	1.67
D+	1.33
D	1.00
D-	0.67
F	0.00

P—Passing mark obtained under the Pass-Not Pass system. See *Index, Pass-Not Pass*.

NP—Non-passing mark obtained under the Pass-Not Pass system. See *Index, Pass-Not Pass*.

S—Satisfactory completion of a course offered on a Satisfactory-Fail grading basis. May also be reported to indicate satisfactory performance in R (non-credit) courses, and in courses numbered 290, 490, 590, and 690.

T—Satisfactory performance (equivalent to a grade of C or better in courses numbered 100-499, and a grade of B or better in courses numbered 500-699) in a special examination for academic credit.

X—The course was officially dropped by the student after the first week of the term.

N—No report was submitted by the instructor. This is not a recognized grade or mark; it merely indicates the instructor has not submitted a grade and that a grade report has been requested.

I—Incomplete. An incomplete mark may be assigned when the student is passing at the time of the request, but special circumstances beyond the student's control prevent completion of the course. In general, failing the final exam or project or not submitting course work as a result of inadequate preparation or learning are not valid excuses.

The student and instructor must complete and sign an incomplete contract (Incomplete Mark

Report form) that states the reason for the I, the requirements for resolving it, and the date by which it must be resolved, not to exceed one calendar year. The instructor then enters an I on the final grade report, attaches the form to the report, and submits both to the registrar.

If the student is not available at the end of the term to sign the Incomplete Mark Report form because of ill health or other reasons, the instructor may assign an incomplete mark and submit the form without the student's signature. The Office of the Registrar will record the incomplete mark and mail a copy of the form to the student. If the student chooses not to accept the incomplete, the student has until midterm of the following semester to contact his or her instructor and request a grade be submitted to the registrar. If the student has not contacted the instructor by midterm, the student must resolve the incomplete according to the conditions set forth in the Incomplete Mark Report form.

When a student completes the requirements specified on the Incomplete Mark Report form, the instructor submits the appropriate grade, which becomes part of the student's cumulative, but not term, grade-point average. The grade does *not* replace the I on the record. The I remains on the record for the applicable term.

A final course grade, once submitted to the registrar, may not be changed to an Incomplete except to correct an error at the request of the instructor and with the approval of the instructor's department head and the dean of the instructor's college. The instructor should send a card (Grade Report to the Registrar) reporting the change, and an Incomplete Mark Report form to the appropriate dean who will forward them to the registrar if the change is approved.

Incompletes in all courses must be resolved by the middle of the student's term of graduation. Repeating a course will not resolve an I mark. A mark of I will automatically change to a grade of F after one calendar year (whether or not the student was enrolled during the period).

2. To change a grade or mark already reported to the registrar, the instructor submits a change card (Grade Report to the Registrar). This card is used for replacing an I with a grade, for correcting an instructor error, or for the late report of a grade.

3. The registrar will transmit notification of C-, D, and F midterm grades and incorrect registrations to advisers, and will also attempt to notify students of midterm grades and incorrect registration. In addition to returning the midterm list, the instructor is responsible for informing the class of the basis on which midterm grades have been submitted.

4. Grades in all courses attempted remain on each student's record. If a course is repeated, the record will show the grade obtained on the initial attempt as well as grades received on subsequent attempts.

5. The cumulative grade point average is calculated by dividing the total number of quality points earned by the total number of credits in all courses attempted. Grades of S, P, NP, and

T are not counted in calculating the grade point average. If a course is repeated, the cumulative grade point average is calculated according to the process described in item 6a below.

6. Repeating Courses.

- a. The most recent grade for a course a student repeats will be used in computing the student's cumulative grade point average rather than the previous grade(s), up to a limit of 15 credits. (This could result in a lowered grade point average if the second grade is lower than the first, or even loss of credit if the grade is lowered to an F.) All grades will remain on the student's record.
- b. Students may repeat any course for which an F grade or any passing grade except P or S was received, but they may not elect to repeat the course under the Pass-Not Pass system.
- c. Beyond 15 credits of repeats, both grades will be included in computing the cumulative grade point average.
- d. Courses should be repeated as soon as possible, preferably within three semesters in residence, because of changes that occur with course updating, change in course number, or revision in number of credits. Approval to repeat a course after more than three semesters have elapsed must be noted on a Designation of Repeated Course form, which can be obtained from departmental offices. This form must be signed by the head of the department offering the course and by the student's adviser, and then taken to the Office of the Registrar. This form must also be used in cases in which the course number or number of credits has changed. Deadlines for filing repeated course forms for full-semester and half-semester courses are published in the University Calendar.
- e. Transfer students may repeat courses at Iowa State University for which a D or F was received at another institution. They must process a designated repeat form indicating they are repeating the course to reduce a transfer deficiency. Such repeated credits will count toward the 15-credit request limit and will affect only their transfer deficiency.
- f. A student who has earned an F at Iowa State University may repeat the course at another institution and the credits earned may be applied toward graduation at Iowa State, but the grade earned will not be used in computing a cumulative grade point average.

7. Students who want to protest a grade submitted by an instructor should follow the procedures described in the section on *Appeal of Academic Grievances*.

Academic Progress

Each college has an academic standards committee that is responsible for monitoring the academic progress of all undergraduate students in that college, based on policies and minimum requirements set by the Faculty Senate Committee on Academic Standards and Admissions and ratified by the Faculty Senate. Individual college faculties may, with the approval of the Faculty Senate Committee on Academic Standards and Admissions, set additional requirements that are not lower than those established for the university. These

additional requirements must be reviewed at least every third catalog by the college academic standards committee to determine if they should be continued. Subsequent action by the university committee is required only when the additional requirements differ from those already approved. The college committees are responsible for actions involving individual students with respect to placing students on temporary enrollment, dismissing students from the university for unsatisfactory academic progress, and reinstating students who have been dismissed. For questions concerning interpretation and application of the rules governing academic progress, students should contact the chair or secretary of their college academic standards committee in the administrative office of their college.

The university's academic standards rules are presented below. In addition to taking action based on these rules, a college academic standards committee may also place a student on temporary enrollment or dismiss a student from enrollment in the university when, in the college committee's judgment, the student's academic performance or progress toward a degree is exceptionally deficient. Likewise, a college committee may, under exceptional circumstances, exempt individual students from the application of these rules.

Students who participate in the Regent Universities Student Exchange Program, or in a similar program where the credit taken at the other school will be considered as resident credit and the grades included in the student's ISU cumulative grade point average, are subject to Iowa State University's academic standards.

Temporary Enrollment Status and Academic Dismissal

Students are placed on temporary enrollment status as a warning that their academic progress is not satisfactory and that they must improve their academic performance to avoid dismissal from the university. Students who are placed on temporary enrollment should immediately seek assistance in academic improvement from such sources as academic advisers, instructors, the Student Counseling Service, and the University Tutoring Office.

Students may be admitted to Iowa State University on temporary enrollment or may subsequently be placed on temporary enrollment as a result of unsatisfactory academic performance. Students on temporary enrollment status who do not meet the minimum requirements described below will be dismissed from enrollment in the university.

Decisions regarding temporary enrollment and academic dismissal are based on the student's cumulative quality-point deficiency. The number of deficient quality-points is determined by subtracting the total number of ISU quality-points from twice the number of ISU credits attempted. If a student enters Iowa State University with a quality-point deficiency, this deficiency will be added to any deficiency accumulated at Iowa State University to determine the cumulative quality-point deficiency.

Example: Assume a student has attempted 65 credit hours of coursework, and has a cumulative grade-point average of 1.80. This student needs 130 quality points (i.e., 65 credit hours x 2.00 points) in order to have zero quality-point deficiency. The student currently has earned 117 quality points (i.e., 65 credit hours x 1.80 grade point average**). Thus, the student currently is deficient by 13 quality points (i.e., 130-117).

Assume the student must remove this 13 quality-point deficiency over the next 30 credit hours. The student would need to earn 73 quality points (i.e., 30 credit hours x 2.00 quality points = 60 quality points) in order to not add to the deficiency. Thus, a grade-point average of 2.44 (i.e., 73 quality points/30 credit hours) for the next 30 credit hours is needed to remove the deficiency.

Students who are placed, or continued, on temporary enrollment at the end of the spring semester may enroll for the summer term without being placed in jeopardy of academic dismissal from the university at the end of that summer term. However, the cumulative quality-point deficiency at the end of the summer term will be used for temporary enrollment decisions. This is true for all students enrolled in the summer term. Students considered for academic dismissal at the end of spring semester will be permitted to enroll for the summer term. The cumulative quality-point deficiency at the end of the summer term will be used to determine whether the student should be permitted to continue. The individual colleges determine if students reinstated for the spring semester will be permitted to utilize the summer term option. (Reinstated students should also see the section on Reinstatement.)

1. Students with fewer than 90 credits attempted or earned,* whichever is greater, will be placed on temporary enrollment at the end of any semester or summer term when their cumulative quality-point deficiency equals 10 or more quality points. At the end of any term in which a student is on temporary enrollment, the student will be:

- a. dismissed from enrollment in the university if the cumulative quality-point deficiency has increased;
- b. continued on temporary enrollment if the cumulative quality-point deficiency has not increased but remains 10 or more;
- c. removed from temporary enrollment if the cumulative quality-point deficiency is now less than 10.

2. Students with 90 or more credits attempted or earned,* whichever is greater, will be placed on temporary enrollment at the end of any semester or summer term when they have any quality-point deficiency. At the end of the term in which a student is on temporary enrollment, the student will be:

- a. dismissed from enrollment in the university if the cumulative quality-point deficiency has increased;
- b. continued on temporary enrollment if the cumulative quality-point deficiency has not increased but remains greater than zero;
- c. removed from temporary enrollment if the cumulative quality-point deficiency has been removed.

3. A student on temporary enrollment may transfer to another college within the university only with the permission of the department executive officer (DEO) of the new department and dean of the new college. Transfer during period 3 (after the last day to drop a course) may be approved by the DEO of the new department and dean of the new college only under exceptional circumstances. The student will be subject to any additional specific academic requirements determined by the academic standards committee of the college to which the transfer is made.

4. A student who has transferred from a college while on temporary enrollment cannot transfer back unless permission is granted by the academic standards committee of the original college.

5. A student on temporary enrollment who withdraws during period 3 will not be permitted to enroll the following term, except under extenuating circumstances as judged by the college academic standards committee.

Additional Academic Progress Regulations

1. Colleges, departments, or programs may have special grade point requirements for admission, continuation, or graduation. These are presented in connection with statements of college and department curriculum requirements.

2. Engineering: In addition to the requirements listed above, students enrolled in the College of Engineering with 60 or more credits attempted or earned,* whichever is greater, will be placed on temporary enrollment at the end of any semester when they earn less than a 2.00 grade point average for that semester. Students placed on temporary enrollment under provisions of this requirement will be dismissed from enrollment in the university if they fail to achieve, for the following semester, at least a 2.00 semester grade point average.

Summer term grades will be combined with the student's grades for the prior term completed to form a single semester grade point average to be used for temporary enrollment and academic dismissal decisions. Credit hours and quality points will be combined for the purpose of obtaining the average. When courses are repeated, both grades will be used in this computation.

*"Attempted" refers to credit hours both passed and failed at Iowa State University; "earned" includes transfer credits and credit hours passed at Iowa State University.

**Total quality points can also be determined by summing the quality points associated with each letter grade earned for each of the 65 credit hours completed by the student. See page 46 for quality points associated with each letter grade. For example, assume this student has earned 52 credit hours of C and 13 credit hours of D. Total quality points may be determined:

52 x 2.00=104.00	quality points for C grades
13 x 1.00=13.00	quality points for D grades
117.00	total quality points

Students considered for academic dismissal at the end of a spring semester under provisions of the preceding paragraphs will be permitted to enroll for the following summer session.

3. Veterinary Medicine: Additional rules for minimum satisfactory progress are in effect.

4. Special students: Students matriculated in this classification category are governed by the regular academic progress regulations. Furthermore, by special action of their college academic standards committee, additional standards may be required.

Reinstatement

The procedures delineated in this section apply to students who were dismissed from Iowa State for academic reasons. Students who left Iowa State in good academic standing and who are seeking reentry should see the section titled *Reentry* on page 40 for details.

1. Reinstatement is not automatic. A student who has been dismissed for academic reasons should contact the Dean's Office in the college he or she wishes to enter for instructions specific to that college. The college Academic Standards Committee reviews each petition and other relevant information, and reinstatement is based upon that review. The student must identify the causes of her or his poor academic performance, and demonstrate that he or she has taken actions to avoid or eliminate these causes. The student must submit a plan for academic success.

2. A student can only be reinstated when at least one academic semester has elapsed since she or he was academically dismissed. The summer session is not a semester for the purpose of being out of school one semester.

3. A student who has been dismissed from enrollment two or more times is not eligible for reinstatement until at least two academic semesters have elapsed since his or her last academic dismissal.

4. A student who was dismissed by one college and subsequently reinstated by another college cannot transfer back unless permission is granted by the Academic Standards Committee of the original college. This procedure applies regardless of the student's current academic standing.

5. To be considered for reinstatement to the university, a student must file a reentry form and submit a petition to the Academic Standards Committee of the college in which she or he desires to enroll at least 45 days before the beginning of the semester. (A student dismissed for the second time and requesting reinstatement in the College of Liberal Arts and Sciences must submit his or her petition 70 days before the beginning of the semester.)

6. As conditions of reinstatement, a student will reenter on temporary enrollment, and must accept whatever additional requirements are stipulated by the college Academic Standards Committee. Some examples may include full- or part-time status, specified credit hours, specific courses, specific GPAs, restriction on choice of major, and required counseling. Other conditions may also be imposed.

Student Appeal

1. Students may appeal a decision regarding their academic status if they believe that new information can be provided or extenuating circumstances exist that would alter the application of any rule in this section. The appeal should be made in writing to the Academic Standards Committee of the college in which the student is enrolled. The written appeal must include the reasons for the appeal and the evidence to substantiate these reasons.

The student should initiate the appeal process by contacting the secretary of the college Academic Standards Committee in the administrative office of her or his college immediately upon receipt of notification of the committee's action, and at least ten calendar days before the beginning of the semester. The secretary will then inform the student of the deadline for submission of the written appeal.

2. If the student is dissatisfied with the committee's action, he or she may submit an appeal in writing to the dean of her or his college within seven calendar days. The dean must respond in writing within seven calendar days of receipt of the appeal.

3. If the issue is not resolved within the college, further appeals may be made in writing to the provost and subsequently to the president of the university. Appeals beyond the college level will, however, be considered only if based on one or both of the following contentions: (a) appropriate procedures were not followed at the college level; (b) academic rules were not applied correctly at the college level.

Removal of Unmet High School Requirements

In some instances, students are admitted to the university and permitted to enroll with a limited number of unmet high school requirements. Any unmet high school requirement must be removed within one year (12 months) of enrollment at Iowa State University. The following procedures apply.

1. Students may remove their unmet requirements by satisfactorily completing the necessary ISU courses. Courses taken to remove deficiencies will be used in the student's degree program as they normally would be used.

2. Students may also take coursework at another institution to remove their unmet requirements. However, students will be informed that evidence of satisfactory completion of the courses must be available to ISU officials by a specified deadline.

3. Students are required to remove their unmet requirements within one year of their enrollment at ISU, even though they may withdraw or drop out of school during the first year. The College of Liberal Arts and Sciences allows students until the end of their third year to remove unmet Foreign Language requirements.

4. It will be up to the college Academic Standards Committee to determine if students should be granted extensions of time due to extenuating circumstances.

5. During the year that they are attempting to remove their unmet requirements, students will be permitted to register for each succeeding term at ISU. If they do not remove their unmet requirements by the end of that year, their registration will be canceled and a hold placed on their record.

Academic Renewal Policy

Students who are returning to Iowa State University to pursue an undergraduate degree after an extended absence may request permission to remove one or more of their complete academic terms from future degree and GPA considerations.

1. Eligibility. To be eligible for academic renewal consideration, students must meet these requirements:

- Students must not have enrolled at Iowa State University for five or more consecutive years.
- Students must not have graduated from Iowa State University.
- Students must currently be in good academic standing. (If the student was previously dismissed, he or she must be reinstated.)

2. Conditions. Academic renewal is based on the following conditions:

- All courses and credits that were taken during the chosen terms will be removed from consideration for GPA and degree requirements. Students may not combine courses from multiple terms to comprise the semester(s) or quarter(s) dropped. Degree requirements met during the dropped terms will ordinarily have to be repeated.
- Renewal may be applied only to academic terms completed prior to the students' extended absence.
- All courses and grades for the chosen terms will remain on the students' academic record.
- Designated repeats, drops and P/NP options will be reinstated for the terms dropped.
- Students who have used all of their drop options will be given one extra drop.
- Students may be granted only one academic renewal.

To be eligible for a degree, students must complete a minimum of 24 credit hours at Iowa State after the granting of academic renewal.

3. Procedures.

- Students should discuss their desire to pursue academic renewal with an adviser in the college they wish to enter.
- Students should submit a petition for academic renewal to the Office of the Registrar. Students may obtain a petition from their college office.

Satisfactory Academic Progress for Financial Aid Recipients

In order to remain eligible to receive financial aid from the student aid programs listed below, a student must meet both quantitative and qualitative academic standards as described within this policy. These standards are minimum expectations; specific aid programs may require a higher level of progress.

A student not in compliance will be unable to receive aid from these programs until the deficiency has been corrected. Progress toward a degree will be reviewed each term and enforced at intervals no longer than one year. The programs affected by this policy are:

- Pell Grant
- Supplemental Educational Opportunity Grant (SEOG)
- Iowa State University Grant
- College Work-Study Program (CWSP)
- National Direct Student Loan (NDSL)
- Health Professions Student Loan (HPSL)
- Federally Insured Student Loan (FISL)
- Guaranteed Student Loan (FSL)
- PLUS Loan
- Health Education Assistance Loan (HEAL)
- University Long-Term Loan

1. The quality standard is described in the section, Academic Progress, beginning on page 44. All students must meet these standards for continued enrollment in order to remain eligible to receive financial aid.

2. The quantity standard for full-time undergraduate students is described below:

- Duration of eligibility. Students may receive federal and institutional aid for a maximum of six academic years or twelve semesters. Students who have not accumulated sufficient credit hours at the end of this time period to complete their course of study will not be eligible to continue to receive financial aid.
- Annual credit hours to be earned. An undergraduate student who receives financial aid from one or more of the programs cited above must complete credit at a rate at least equal to the scale below, where the numbers in the top row indicate academic years completed, and those in the bottom row indicate credit hours required:

1	2	3	4	5	6
15	30	51	72	96	120

3. The quantity standard for all part-time students:

- The duration of eligibility for part-time students is the same as above, but adjusted by the rate of attendance. For example, a student with a maximum duration of six years who is attending school half-time would have the duration of eligibility adjusted to twelve years.
- Part-time students who are otherwise eligible for financial aid must maintain the academic standards or rate of completion as stated above, adjusted by the number of hours attempted at the time the financial aid was disbursed.

9 to 11 credit hours = 3/4 time
6 to 8 credit hours = 1/2 time

4. Regaining eligibility. If a student is denied financial aid because of failure to comply with the above standards, the additionally required credit must be earned at the student's own expense at Iowa State University, or the student must transfer sufficient hours taken at another institution to make up the deficiency.

5. Transfer students. A student transferring to Iowa State University for the first time will be

treated as a first-term student and will not be held responsible for previous terms or credit hours taken at former institutions. If a student attends Iowa State University, transfers to another institution, and then transfers back to Iowa State, the credits earned at the other institution will be added to the student's total earned credit hours.

6. Noncredit courses. Noncredit courses may be converted to credit hours by translating weekly contact hours as defined by the Office of the Registrar.

7. Appeals. Students ineligible for financial aid as a result of this policy, or ineligible for any other reason, may appeal this decision by submitting in writing extenuating circumstances beyond their control that affected their progress to the director of the Student Financial Aid Office and/or the designated representative. The appeal may be accompanied by a recommendation from the student's academic adviser. If this appeal is denied, a further appeal may be made to a committee composed of the chair of the University Financial Aid Committee, the chair of the University Academic Advising Committee, and the director of Student Financial Aid. Appeals of other financial aid decisions, including loss of athletic grants-in-aid, shall also follow this procedure.

8. General Information and Definitions

- Guaranteed Student Loan/Parent Loans for Undergraduate Students (GSL/PLUS). Applications will not be processed or checks released for a GSL/PLUS loan for any student who is not in compliance with the minimum standards described in this policy. Students should be aware that different state and guarantee agencies may have additional and varied standards that must be met before a loan can be granted.
- Incompletes, repeated courses, withdrawals. A student who receives an Incomplete, repeats a course, or withdraws may continue to receive financial aid upon reentering the university as long as the student completes the required credit hours for each academic school year and maintains the minimum quality-point standards. However, the duration of eligibility will not be extended for a student who withdraws or repeats a course. (See the section *Duration of Eligibility*.)
- Exceptions to the policy.
 - Professional students. For those students enrolled in the College of Veterinary Medicine, eligibility will be based on the academic criteria of the college.
 - Special undergraduate students. These students are eligible for GSL only, and must maintain a minimum GPA of 2.00.
- Academic school year. This includes the summer session and regular semesters within any 12-month period. Credits earned during the summer session will be included when totaling credit hours earned each academic year.
- Changes in program of study. The duration of eligibility will not be extended for a student who changes from one program of study to another. (See the section *Duration of Eligibility*.)

These academic progress criteria are defined in minimal terms. If the student earns only the minimum credit hours for financial aid eligibility, the student's total eligibility for particular programs may be exhausted prior to degree completion. (See *Duration of Eligibility and Credit Hour Earning Scale*.) In addition, the student's college or department may require more credit hours than required by this policy.

Sources of Help with Academic Problems

If students are having trouble in a course, the following persons and places may be able to provide help:

1. The instructor of the course may be able to help the student determine the problem with the course and recommend methods for improvements.
2. The student's adviser may be able to recommend support services or remedial strategies.
3. The office of the department that offers the course may have a list of persons qualified to provide tutoring services for the course. The locations of the department offices are listed in the front of the ISU Directory.
4. The Student Counseling Service provides professional counseling services for students with problems which affect academic performance. Tutoring may be arranged through Tutoring Services in the Dean of Students Office.

Scholastic Recognition

The university recognizes those students who are doing exceptionally well in several ways.

1. **Dean's List.** Each semester the university issues a dean's list made up of those students who have carried at least 12 hours of graded or S-F courses with a 3.50 grade-point average or above for the semester. Courses taken on a P-NP basis do not count as part of the 12-hour requirement. No dean's list is issued for summer school.
2. **Annual Recognition Ceremony.** In the spring the university sponsors a ceremony at which high scholarship students in all classes are recognized.
3. **Graduation with Distinction.** Undergraduates who have a cumulative grade point average of 3.50 or higher at the beginning of their final term are graduated "with distinction" provided they have completed 60 semester credits of coursework at Iowa State University at the time they graduate. Of these 60 credits, 50 graded credits are required. This recognition appears on the student's permanent record and diploma, and in the commencement program. Recognition for students graduating in veterinary medicine is based only on the grades earned while enrolled in that college. Candidates for the bachelor of liberal studies degree may be graduated with distinction providing that they (a) have achieved a cumulative grade point average of 3.50 or higher for all ISU credits; (b) have achieved a cumulative grade point average of 3.50 or higher for all other credits taken at the other Iowa Regent universities; and (c) have completed 45 semester credits of coursework at the three Iowa Regent universities at the time of graduation.

Academic Privileges and Opportunities

A. Credit by Examination

Academic credit may be earned by means of special examinations. The Credit by Examination (CBE) program is available to current Iowa State students as well as prospective and entering students. Students with college-level proficiency in particular areas are encouraged to investigate credit by examination early in their college careers. Information regarding policies and procedures governing Credit by Examination may be found on page 13.

B. Pass-Not Pass Grading

Students who want to broaden their education at Iowa State may choose to take a maximum of 9 semester credit hours on a Pass-Not Pass basis, meaning that only a P or NP will be recorded as their final grade in the course. The purpose of P-NP grading is to encourage students to take courses outside the usual program of study for their major and minor disciplines. The following policies apply:

1. Undergraduate students who have earned at least 40 semester credits and who are not on temporary enrollment at the beginning of the semester are eligible. A special student must obtain approval from her or his academic adviser and college dean.
2. Only elective courses may be taken on a P-NP basis. In specific majors, some restrictions may apply, so students should consult with their academic adviser.
3. Except for restrictions on its own undergraduate majors, a department may not deny the availability of any of its course offerings on a P-NP basis.
4. Courses offered on a satisfactory-fail basis may not be taken P-NP.
5. Students should register for a P-NP course via the Touch-tone Registration System in the same manner and at the same time that they register for their other courses. Students should then change to P-NP by processing a schedule change form with their academic adviser's signature in the P-NP approval section of the form.
6. Students who elect to change back to a graded basis should process the change using the P-NP section of the schedule change form.
7. Changes to or from a P-NP basis may be made within the period ending the second Friday following the date on which midterm grades are due (or until three weeks before the end of a summer session). See *Index, Schedule Changes*. If the change from P-NP to a graded basis is made after the first 10 class days of a semester (first five days of summer session), the course will count toward the total P-NP credits allowed.
8. Registration on a P-NP basis is not indicated on the instructor's class list. Students will receive a P if their grade is D minus or better and an NP if their grade was F.

9. Neither P (earned grade of D minus or better) nor NP (earned grade of F) is counted in calculating a student's grade point average (GPA).

10. Students who pass a course taken under the P-NP system may not repeat the course. When students have taken a course and received a grade, they may not repeat it for P-NP credit.

11. When students change their curriculum, any P credits that they have accumulated will be accepted by the new department if such credits are in courses normally accepted by the department.

12. Credits taken on a P-NP basis at another institution and transferred to Iowa State may be applied as electives in a student's degree program if the credits are otherwise acceptable in that program. The number of P-NP transfer credits that can be accepted depends on the number permitted by the institution from which the student is transferring. If a student transfers more than nine semester P-NP credits, no additional Iowa State P-NP credits can be applied to the student's degree program.

C. Auditing

To audit a course means to enroll in the course without receiving credit for it. Auditing a 500- or 600-level course requires the permission of the instructor. Students are assessed fees as though they were taking the course for credit, and the course counts in determining full-time or part-time student status. Changing a course from credit to audit requires dropping the course for credit and adding it as an audit on a schedule change request form. If this occurs after day 5 of the semester, the drop will count toward the total allowable ISU drops.

Requests to audit a course will be honored only if there is space available in the course after the four-week touch-tone registration period has ended. Once enrolled in a course, auditors have the same rights and privileges as any student taking the course for credit. Their names appear on the class list with a notation that they are auditing. To change the status of an audited course to a graded course, students must process the schedule change request form by day 5 of the semester. Audited courses do not appear on the student's permanent record except by special request from the student and the student's adviser with evidence showing that the student was actively involved in the course. Audited courses do not apply toward V.A. benefits.

An agreement to audit a 500 or 600 level course must be negotiated between the student and the course instructor. An audited course counts for only one credit in the graduate student's allowable course load; however, fees will be assessed for the full number of credits for the course.

D. Independent Study

Most departments offer opportunities for independent study through a 490 course listing. Usually a minimum of 6 to 10 credits of coursework in the department is required before independent study is permitted. Students who are interested in this kind of experience in a particular department should

check the catalog to determine the department's prerequisites to register for 490. 490H sections are reserved for students in the University Honors Program.

Students should check with the department about procedures, in addition to meeting the prerequisites, for registering for 490. A written plan of study is prepared in advance with a faculty member who has agreed to supervise the student's work, to evaluate progress and the final product, and to assign a grade. Initiation of the plan of study should occur prior to the semester in which enrollment is desired. Both the student and the instructor should agree on the number of credits for which the student will enroll, the amount and kind of work he or she will do for that credit, and the system by which she or he will be graded (A-F or S/F). Students should not expect to register for or add 490 credit without an instructor's permission. Some colleges and/or departments have limits on the number of credits of 490 that may be applied toward graduation.

Appeal of Academic Grievances

Students who believe a faculty member (in his or her academic capacity) has behaved unfairly or unprofessionally may have their grievance reviewed through the procedure described below. A student may not initiate an appeal more than one year following completion of the course, and may not initiate the appeal of a course grade beyond midterm of the semester following her or his completion of the course.

Prior to initiating a formal appeal, a student may wish to discuss the situation informally with a staff member of the Dean of Students Office, who can offer advice as to the most effective way to deal with it.

Grievances arising out of classroom or other academic situations should be resolved, if at all possible, with the individual instructor involved. If resolution cannot be reached, or if the grievance involves sexual or racial harassment and the student prefers not to deal directly with the instructor, a student should discuss the grievance with the instructor's department chair and submit it in writing to him or her. The department chair will discuss the grievance with the instructor involved and/or refer it to a departmental grievance committee. The department chair should respond in writing within five class days. If resolution of the grievance cannot be made with the department chair, the student may appeal in writing to the dean of the instructor's college. (In the case of a grievance involving a Graduate College policy or procedure, an appeal of the department chair's decision should be directed to the Dean of the Graduate College rather than to the dean of the instructor's college.) The dean will hear the explanations of the department chair and instructor, and should respond to the student in writing within ten class days. If the grievance cannot be resolved with the dean, the student may forward a written appeal to the provost, who will convene a quorum of the Committee to Review Student Grievances (see below) to hear the appeal within ten class

days. Within five class days following the hearing, the provost will make a decision in regard to the grievance and will transmit this decision to the grievant, the dean, the department chair, and the instructor. An appeal of the provost's decision may be made to the president of the university. The time limit specified at each level may be extended by mutual agreement of all parties concerned.

The Committee to Review Student Grievances is composed of ten faculty members named by the president of the Faculty Senate and ten GSB senators named by the president of the Government of the Student Body. The provost serves as a chairperson for the committee, but may designate another chairperson for a specific grievance hearing. Faculty members are appointed for a three-year term, with three or four being replaced each year. Students are appointed for one-year terms renewable at the discretion of GSB. A minimum of two faculty members, two students, and the chairperson shall constitute the quorum for a grievance hearing.

Student Records

Iowa State University maintains various records concerning students, to document their academic progress as well as to record their interactions with university staff and officials. In order that their right to privacy be preserved and to conform with federal law, the university has established certain policies to govern the handling of student records.

Public Information

Certain information concerning students is considered to be open to the public upon inquiry. This public information is of two types: directory information and other information not included in the ISU Directory. Directory information includes local address, telephone number, and electronic mail address; home town, college, curriculum, year in school, and enrollment status. Other public information includes mailing address, date and place of birth, dates of attendance at Iowa State, expected date of graduation, names of advisers, awards and academic honors, Iowa State degree(s) and date(s) awarded, previous educational institutions attended, degrees received, dates of attendance, full- or part-time status, participation in officially recognized activities and sports, and weight and height of members of athletic teams.

Public information will be released by the registrar to anyone upon inquiry, unless students have requested that their information not be released. A request to have public information withheld should be made at the Office of the Registrar, 214 Alumni Hall. If the request is granted, the registrar will notify the appropriate university offices.

It is the policy of the university to respect the privacy of students; therefore, only lists and labels containing names of students with directory information will be made available to members of the public. This directory information will be provided on a time-available basis for the cost of producing the information. Directories are also available in the bookstores

for those persons needing directory information. Directory information is available on the World Wide Web using the on-line phonebook; and from printed directories, which may be purchased at the bookstores.

Confidential Information

With the exception of the information noted above, all student records are considered to be confidential and are open only to university personnel; to offices and agencies carrying out their accreditation and audit functions of university programs; to persons in compliance with a judicial order; to organizations conducting studies for or on behalf of educational institutions or agencies for the purpose of developing, validating, or administering predictive tests, administering student aid programs, and improving instruction; and to persons in an emergency in order to protect the health or safety of students or other persons.

The following policies govern access to student records:

1. Each type of student record is the responsibility of a designated university official, and only that person or the dean or director to whom that person reports has authority to release the record. The responsible officials are:

- a. Academic records: registrar
- b. Admissions records: director of admissions
- c. Financial aid records: director of student financial aid
- d. Business records: university controller
- e. Traffic and security records: director, ISU Department of Public Safety
- f. Medical records: director, Student Health Center
- g. Counseling records and test scores: director, Student Counseling Service
- h. Actions of Academic Standards Committees: college deans
- i. Disciplinary records: dean of students
- j. Residence hall records: director of residence
- k. Placement records: college placement officers
- l. Evaluations for admission to ISU graduate or professional programs: deans or department chairs
- m. Special academic programs: faculty member in charge of the program and the dean of the college.

2. The responsible official may release records to university personnel who have a legitimate need for the information. "University personnel" includes students appointed to specified committees. A list of those persons who normally have access to each type of student record is available in 214 Alumni Hall.

3. All student records are reviewed periodically. Information concerning the frequency of review and expurgation of specific records is available in 214 Alumni Hall.

4. Students have the right to review upon request any records that pertain directly to them, and may obtain a copy of the record at cost. This provision does not apply to records to which the student has waived his or her right to review, nor does it apply to medical and counseling records.

5. A student may waive the right to review a specific record by submitting in writing a statement to this effect to the official responsible for that record.

6. A file containing copies of records pertinent to advising is maintained on each student for use by the student's adviser. Ordinarily this file is kept in the possession of the adviser, but for convenience it may be stored elsewhere such as in the department office. When the student changes majors, or changes advisers within the same major, the file is transferred to the new adviser. Under the university's student records policy, the student is considered to have the right of access to this file.

7. Medical and counseling records shall be released at the written request of the student to medical or psychological professionals outside the university or to university officials.

8. University personnel who have access to student records in the course of carrying out their university responsibilities shall not be permitted to release the record to persons outside the university, unless authorized in writing by the student or unless one of the exceptions stated earlier is involved.

9. Confidential information may be released to parents by obtaining the student's written consent or by having the parent establish the student's dependency as defined by the Internal Revenue Code of 1954, section 152, by furnishing a certified copy of the parent's most recent federal income tax return.

10. Iowa high schools receive a freshman year report containing first year academic progress data of all their graduates attending Iowa State University for the purpose of evaluating and improving their instructional programs.

11. The officials responsible for custody of student records will maintain records of requests and disclosures of personally identifiable non-public information. The records of requests, whether granted or not, shall include the person or agency requesting the information and

the purpose of the release. These records of requests and disclosures will be available to the student on request. Records of requests and disclosures are not necessary for requests made by the student, by school officials in carrying out their official responsibilities, by persons employed by agencies and offices conducting audits and accreditations of university programs, or any of the other exceptions listed previously.

Posting Grades and Test Scores

The test scores or course grades of students may be posted in public locations to inform students of their performance provided that the information is presented in such a way as not to reveal the name or entire social security number of specific individuals.

Release of Grades

Reports of a student's grades are not routinely sent to the student's parents. Parents of students under 18 years of age may obtain grades by writing to the Office of the Registrar. The grades of other students will be sent to their parents only with written permission of the student, or by establishing dependency as outlined in item 9 under Confidential Information.

When Records May Be Withheld

The appropriate university official may request that a student's record not be released if that student is delinquent in an account with the university or an affiliated organization. The effect of this action is that a transcript will not be released and registration will be withheld.

The appropriate official may also request that records be withheld in instances when official disciplinary action has been taken against a student. Authorization for these actions is supported by The Iowa Code and The Iowa Administrative Code.

In order for such an action to be rescinded, the Office of the Registrar must receive written authorization from the official who originally requested the action, indicating that the student has met the obligation. Further information about this policy can be obtained from the Office of the Registrar.

Review and Challenge of Records

A student may challenge the accuracy of handling of records maintained by the university on grounds that the records are inaccurate, misleading, or otherwise violate the privacy or other rights of the student. The university has established the following procedures to provide an opportunity for the student to correct or delete inaccurate records, or to insert into the record a written explanation of the content.

Students who question their records should discuss the issue first with the individual staff person who established or maintains the records. Presumably most issues can be resolved at this level. If a satisfactory resolution cannot be reached, the student should submit the question to the head of the department in which the record is maintained.

The department head will discuss the issue with the staff person and the student challenging the record. If resolution cannot be reached after meeting with the department head, the

student may submit the question to the dean or director to whom the department head is responsible. The dean or director will investigate, and will respond in writing.

If the record has not been reconciled through these measures, the student may direct a written request to the president of the university. The president will convene an Ad Hoc Hearing Panel of Access and Confidentiality of Educational Records, composed of two faculty members, two students, and one administrator, appointed by the president for a period of one year, with the president or a designee serving as nonvoting chairperson. The student shall be given an opportunity to present to the panel evidence relevant to the issues raised, and the panel will issue a written response.

ISUCard and Identification Number

Each student is assigned a random university identification number on entry to the university. This number appears on the ISUCard that is provided to each student at the time of first registration. The ISUCard, along with a current registration receipt, may be required for some services and/or activities. At the time the ISUCard is issued each student also selects a personal identification number (PIN), which is required for electronic access to personal student information.

Loss of an ISUCard should be reported immediately to the ISUCard Office, where the lost card will be invalidated and replaced for a charge. Disciplinary sanctions may be imposed for improper use of the ID card or attempts to obtain, by fraudulent means, any form of identification.

Social Security Number

Social security numbers are collected from prospective and current students, for administrative coordination and record identification purposes only. Although procedures have been established by the registrar for assignment of an alternative number upon request, students who wish to be employed on campus or to receive financial aid are required by law to provide their social security numbers for administrative use. The social security number is a confidential record and is maintained as such by the university in accordance with the Family Educational Rights and Privacy Act.

Policy on Student Names

Iowa Regents universities have a common policy regarding student names and name changes. The name on the student record should be the student's complete and legal name. In evaluating and processing all name change requests, the university reserves the right to require adequate and appropriate documentation as warranted.



Designators

A E	Agricultural Engineering	F Lng	Foreign Languages and Literatures	N S	Naval Science
A Ecl	Animal Ecology	FCEdS	Family and Consumer Sciences Education and Studies	Neuro	Neuroscience
Acct	Accounting	Fin	Finance	OLHRD	Organizational Learning and Human Resource Development
Ad Ed	Adult and Extension Education	For	Forestry	P E	Physical Education
Advrt	Advertising	Frnch	French	P M	Pest Management
Aer E	Aerospace Engineering	FS HN	Food Science and Human Nutrition	P Phy	Plant Physiology
Af Am	African American Studies	Gen	Genetics	Perf	Performing Arts
AFAS	Air Force Aerospace Studies	Genet	Genetics—Interdisciplinary	Phil	Philosophy
AgEdS	Agricultural Education and Studies	Geol	Geology	Phys	Physics
Agron	Agronomy	Ger	German	PI HP	Plant Health and Protection
Am In	American Indian Studies	Geront	Gerontology	PI P	Plant Pathology
An S	Animal Science	Gr St	Graduate Studies	Pol S	Political Science
Anthr	Anthropology	Greek	Greek	POM	Production/Operations Management
Arch	Architecture	H P C	Historical, Philosophical, and Comparative Studies in Education	Port	Portuguese
Art	Art and Design	H S	Health Studies	Psych	Psychology
Art H	Art History	HD FS	Human Development and Family Studies	Relig	Religious Studies
ArtCD	Art: Craft Design	Hg Ed	Higher Education	ResEv	Research and Evaluation
ArtDP	Art: Drawing/Painting/Printmaking	Hist	History	Rus	Russian
ArtEd	Art Education	Hon	Honors	Soc	Sociology
ArtGr	Art: Graphic Design	Hort	Horticulture	Sp Cm	Speech Communication
ArtID	Art: Interior Design	Hous	Housing	Sp Ed	Special Education
ArtVS	Art: Visual Studies	HRI	Hotel, Restaurant, and Institution Management	Span	Spanish
AST	Agricultural Systems Technology	I E	Industrial Engineering	Stat	Statistics
Astro	Astronomy and Astrophysics	I R	Industrial Relations	T C	Textiles and Clothing
Ath	Athletics	I Tec	Industrial Technology	T SC	Technology and Social Change
B M E	Biomedical Engineering	Ia LL	Iowa Lakeside Laboratory	Thtre	Theatre
B M S	Biomedical Sciences	IGS	Interdisciplinary Graduate Studies	Tox	Toxicology
BBMB	Biochemistry, Biophysics, and Molecular Biology	Imbio	Immunobiology	Trans	Transportation
Biol	Biology	IntSt	International Studies	TrLog	Transportation and Logistics
Bot	Botany	Ital	Italian	U St	University Studies
BPM I	Biological/Pre-Medical Illustration	Jl MC	Journalism and Mass Communication	V C S	Veterinary Clinical Sciences
BusAd	Business Administration	L A	Landscape Architecture	V Med	Veterinary Medicine
C E	Civil Engineering	LAS	Liberal Arts and Sciences Cross- Disciplinary Studies	V MPM	Veterinary Microbiology and Preventive Medicine
C I	Curriculum Instruction	Latin	Latin	V P P	Veterinary Physiology and Pharmacology
C R P	Community and Regional Planning	Lib	Library	V Pth	Veterinary Pathology
Ch E	Chemical Engineering	Ling	Linguistics	VDPAm	Veterinary Diagnostic and Production Animal Medicine
Chem	Chemistry	M E	Mechanical Engineering	W Res	Water Resources
Chin	Chinese	M S	Military Science	W S	Women's Studies
CJ St	Criminal Justice Studies	M S E	Materials Science and Engineering	Zool	Zoology
Cl St	Classical Studies	Mat E	Materials Engineering		
CLSMT	Clinical Laboratory Science/Medical Technology	Math	Mathematics		
CmDis	Communication Disorders	MCDB	Molecular, Cellular and Developmental Biology		
Co Ed	Counselor Education	Mgmt	Management		
Com S	Computer Science	Micro	Microbiology		
ComSt	Communication Studies	MIS	Management Information Systems		
Con E	Construction Engineering	Mkt	Marketing		
Cpr E	Computer Engineering	Mteor	Meteorology		
Cyto	Cytotechnology	Music	Music		
Dance	Dance				
Dsn S	Design Studies				
E E	Electrical Engineering				
E M	Engineering Mechanics				
E Op	Engineering Operations				
E Sci	Engineering Science				
Econ	Economics				
EdAdm	Educational Administration				
EEB	Ecology and Evolutionary Biology				
Engl	English				
Engr	Engineering				
EnSci	Environmental Science				
Ent	Entomology				
Env S	Environmental Studies				
Ex Sp	Exercise and Sport Science				



Colleges and Curricula

Undergraduate and Professional Degree Programs

The university is organized into nine colleges, including the Graduate College. Seven colleges offer undergraduate degree programs, and the College of Veterinary Medicine offers the Doctor of Veterinary Medicine degree. For a listing of the more than 100 majors offered by the Graduate College, see the summary at the end of the Graduate College section of this publication.

Iowa State University is accredited by the Commission of Institutions of Higher Education of the North Central Association of Colleges and Schools.

The main undergraduate academic programs of each college are listed below, together with the degrees awarded upon completion. In many cases certain majors, minors, options, or electives allow for increased specialization within the programs. Programs which are administered jointly by two colleges are listed within both colleges.

College of Agriculture

Agricultural Biochemistry, B.S.
Agricultural Business, B.S.
Agricultural Education, B.S.
Agricultural Extension Education, B.S.
Agricultural Studies, B.S.
Agricultural Systems Technology, B.S.
Agronomy, B.S.
Animal Ecology, B.S.
Animal Science, B.S.
Dairy Science, B.S.
Dietetics, B.S.
Entomology, B.S.
Environmental Science, B.S.
Environmental Studies, B.S.
Food Science, B.S.
Forestry, B.S.
Genetics, B.S.
Horticulture, B.S.
International Agriculture, B.S.
Microbiology, B.S.
Nutritional Science, B.S.
Pest Management, B.S.
Plant Health and Protection, B.S.
Professional Agriculture, B.S.
Public Service and Administration in Agriculture, B.S.
Seed Science, B.S.
Zoology, B.S.

College of Business

Accounting, B.S.
Finance, B.S.
International Business, B.S.
Management, B.S.
Management Information Systems, B.S.
Marketing, B.S.
Production/Operations Management, B.S.
Transportation and Logistics, B.S.

College of Design

Architecture, B.Arch.
Art and Design, B.A., B.F.A.
Community and Regional Planning, B.S.
Graphic Design, B.F.A.
Interior Design, B.F.A.
Landscape Architecture, B.L.A.

College of Education

Community Health Education, B.S.
Early Childhood Education, B.S.
Elementary Education, B.S.
Environmental Studies, B.S.
Exercise and Sport Science, B.S.
Industrial Technology, B.S.
Secondary Education (See licensure programs offered by the colleges of Agriculture, Design, Education, Family and Consumer Sciences, and Liberal Arts and Sciences.)

College of Engineering

Aerospace Engineering, B.S.
Agricultural Engineering, B.S.
Chemical Engineering, B.S.
Civil Engineering, B.S.
Computer Engineering, B.S.
Construction Engineering, B.S.
Electrical Engineering, B.S.
Engineering Operations, B.S.
Engineering Science, B.S.
Industrial Engineering, B.S.
Materials Engineering, B.S.
Mechanical Engineering, B.S.

College of Family and Consumer Sciences

Apparel Merchandising, Design, and Production, B.S.
Child and Family Services, B.S.
Dietetics, B.S.
Early Childhood Education, B.S.
Family and Consumer Sciences Education and Studies, B.S.
Family Resource Management and Consumer Sciences, B.S.
Food Science, B.S.
Hotel, Restaurant, and Institution Management, B.S.
Housing and the Near Environment, B.S.
Nutritional Science, B.S.

College of Liberal Arts and Sciences

Advertising, B.A.
Anthropology, B.A., B.S.
Biochemistry, B.S.
Biological/Pre-Medical Illustration, B.A.
Biology, B.S.
Biophysics, B.S.
Botany, B.S.
Chemistry, B.A., B.S.
Computer Science, B.S.
Earth Science, B.A., B.S.

Economics, B.S.
English, B.A., B.S.
Environmental Science, B.S.
Environmental Studies, B.A., B.S.
Foreign Languages and Literatures
French, B.A.
German, B.A.
Spanish, B.A.

Genetics, B.S.
Geology, B.S.
History, B.A., B.S.
Interdisciplinary Studies, B.A., B.S.
International Studies, B.A., B.S.
Journalism and Mass Communication, B.A., B.S.
Liberal Studies, B.L.S.
Linguistics, B.A.
Mathematics, B.S.
Meteorology, B.S.
Music, B.A., B.Mus.
Performing Arts, B.A.
Philosophy, B.A.
Physics, B.S.
Political Science, B.A.
Psychology, B.A., B.S.
Religious Studies, B.A.
Russian Studies, B.A.
Sociology, B.A., B.S.
Speech Communication, B.A., B.S.
Statistics, B.S.
Women's Studies, B.A., B.S.
Zoology, B.S.

College of Veterinary Medicine

Veterinary Medicine, D.V.M.

Bachelor's Degree Requirements

To receive a degree, a student must meet the requirements of the curriculum in which the degree is to be awarded. Verification that the student has met those requirements is made by the dean of the college, who also has the authority to waive a requirement under exceptional circumstances.

A cumulative grade point average of at least 2.00 in all work taken at Iowa State University is required for graduation.

A student admitted as a transfer from another college or university is required to have a 2.00 cumulative average. A student may, however, be admitted with a quality-point deficiency, but will be required to earn sufficient quality-points above a 2.00 at Iowa State to offset the quality-point deficiency at the time of entrance.

No more than 65 semester or 97 quarter credits earned at two-year colleges can be applied to a bachelor's degree from Iowa State University. While there is no limit to the number of credits that may be transferred from a four-year institution, the last 32 semester credits must be completed at Iowa State.

A student who takes work at another college or university after having been enrolled at Iowa State must submit transcripts of all work attempted to the Office of Admissions at Iowa State. This work must average a 2.00 or the deficiency of quality points will be assessed against the student. Failure to submit such transcripts will be grounds for dismissal.

In unusual circumstances, the Academic Standards Committees of the respective colleges may review and give further consideration to the records of students who, except for grade-point average, have satisfactorily completed all graduation requirements. If the appropriate college Academic Standards Committee considers that the educational and professional needs of such a student have been satisfactorily met, or can be satisfactorily met by imposing further conditions, the committee may recommend to the dean of the college that the student be graduated or that a supplemental program be accepted in place of the fully unqualified grade point average. The college Academic Standards Committee chairperson reports such exceptional actions to the Faculty Senate Committee on Academic Standards and Admissions.

To qualify for a bachelor's degree, a student must take a minimum of 32 credits in residence at Iowa State University. Also required is that the last 32 credits must be taken in residence, although under special circumstances, with prior written approval of the student's major department, six of the last 32 credits may be transferred and applied toward a degree at Iowa State University.

A student may receive two bachelor's degrees if he or she meets the requirements of each curriculum and earns at least 30 credits beyond the requirements of the curriculum requiring the greater number of credits. Each degree program must be approved by the appropriate department chair or head.

A student fulfilling the requirements of two separate curricula in different colleges may, in certain cases, receive a degree from one of the colleges with double majors crossing college lines. Each major in a double major must include a minimum of fifteen credits not simultaneously used to meet any other department, college, or university requirement. The permission of both deans must be obtained and each degree program must be approved by the appropriate department and dean.

Minors

Requirements for an undergraduate minor are specified by many departments and programs in the university; a record of completion of such requirements appears on a student's transcript. The purpose of certifying a minor on the transcript is to demonstrate that the student has actively and consciously engaged the intellectual issues central to that discipline.

Lists of undergraduate minors offered by each college appear in the college description; minors offered by cross-disciplinary programs not administered by a single college include gerontology, and international studies. Undergraduate students in any college may elect to meet the requirements of any undergraduate minor offered in the university. Credits used to meet the minor requirements may also be used to satisfy the credit requirement for graduation and to meet credit requirements in courses numbered 300 or above. Some students may, however, have to exceed the graduation credit requirement set by their college in order to meet the requirements of both the minor and the curriculum/major.

All minors require at least 15 credits, including at least 6 credits taken at Iowa State University in courses numbered 300 or above. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement. Courses taken for a minor may not be taken on a pass-not pass basis. Specific requirements and/or restrictions are available from the department or program offering the minor.

English Proficiency Policy

Iowa State University believes that written communication is a fundamental skill of an educated person; therefore its graduates are expected to acquire reasonable competence in written communication during their educational careers. The following are designed to ensure that this competence is developed and maintained:

1. All students must earn credit in a sequence of basic composition courses (English 104 and 105) normally in the freshman year.
2. Continued development of communication skills following the freshman year is the responsibility of the student's major department. This development may be promoted by requiring and critically evaluating term papers and other written assignments as part of courses offered by the department and by encouraging students to enroll in advanced English composition courses that meet their particular needs.

3. Each department is responsible for certifying that its majors have achieved an adequate level of proficiency in written communication at the time of graduation.

English Requirement for International Students

International students whose first language is not English must demonstrate ability to study in this English-speaking university. Such students—beginning as well as those who transfer from other institutions—must take an English placement test when they arrive on campus. The test is administered by the English Department and is offered at the opening of each semester.

Students whose performance on this placement examination is satisfactory will follow the regular English requirements of their major department. Students who have deficiencies will enroll in special English classes, as determined by the test results.

Library Study

Independent study and investigation through the use of books and libraries enable students to grow intellectually and professionally in college and afterward. For this reason, all students receive instruction in the use of the University Library, including practice in how to locate the published literature of their respective fields of study.

U.S. Diversity and International Perspective Requirements

One of Iowa State University's goals is to prepare its students to meet the challenges of responsible citizenship and effective professional roles in a culturally diverse global community. To help achieve this goal, all undergraduate students must fulfill graduation requirements in two areas: U.S. Diversity and International Perspectives. The specific standards used to certify students' fulfillment of these requirements vary from major to major, but all require three credits of course work (or the equivalent in some alternative academic experience) for each of the requirements. In most cases, courses used to meet the U.S. Diversity and International Perspectives requirements can also be used to fulfill general education requirements of the student's college or requirements of the student's major. Students should consult with advisers for details of the requirements in particular majors.

The focus of the U.S. Diversity requirement is the multicultural society of the United States. Courses or alternative academic work used to meet the requirement address significant manifestations of human diversity and provide students with insights that enhance their understanding of diversity among people in the U.S. The focus of the International Perspectives requirement is the global community. Its objective is to promote students' understanding of cultural diversity and interdependence on a global scale. A period of immersion in a

foreign culture is often a particularly effective way of meeting these objectives, so Iowa State University encourages the use of study-abroad experiences as a means of fulfilling the International Perspectives requirement. International students, because they are "studying abroad" from their home country's perspective, are normally deemed to have met the International Perspectives requirement.

Curriculum Requirements

The curriculum requirements, both in number of credit hours and specific courses, are guidelines for the student and his or her adviser in planning an academic program. The curriculum is subject to change and because of these changes, adjustments may need to be made.

Catalog in Effect

A student may choose to graduate under the catalog in effect at the time of graduation, or one of the two immediately preceding catalogs, provided it covers a period of his or her enrollment. Full requirements of the chosen catalog must be met except that adjustments will be made in instances where courses are no longer available or where programs have been changed.

Special Programs Honors Program

The Iowa State University Honors Program is designed for students who have demonstrated the ability and motivation to assume more than the usual responsibility for their undergraduate education. The goal of the program is to enable Honors students to gain maximum benefit from their undergraduate education. Students who graduate in the Honors Program receive the Honors designation on their transcripts and on their baccalaureate diplomas.

Special educational opportunities. Students in the Honors Program determine their educational objectives and devise an individualized program of study to meet those objectives. An honors program may include substitutions for required courses, combinations of courses from several departments to form a new major or minor, Honors courses or seminars, independent study and research, and other forms of innovation. Information about Honors courses and seminars for the current academic year can be obtained from the Honors Program Office, Osborn Cottage.

Other benefits. Members of the Honors Program have 24-hour access to Osborn Cottage as a quiet place to study, use the computers, and visit with other Honors students. Students also have off-campus opportunities such as attending Honors semesters and Wingspread conferences. Full members—those with approved honors degree programs—receive extended loan privileges at the Library, priority scheduling, and the opportunity to apply for research funds.

Eligibility. Students who have a cumulative grade-point average of at least 3.35 become eligible to apply for admission to the Honors Program during their second semester in residence and continue to be eligible for admission as long as they have at least 48 semester

credits remaining before graduation. Decisions with respect to admission are made by the college Honors Program committees.

Freshman Honors Program. Entering freshmen with outstanding high school records and academic ability may be eligible to participate in the Freshman Honors Program. The Freshman Honors Program, which is designed to introduce students to an honors education, consists of special honors sections of English 105 and Library 160, a Freshman Honors Seminar, and advising by specially selected honors advisers. Students may also choose to participate in the Mentor Program, designed to introduce students to the research arena. Participants select an area of interest and are matched with faculty members conducting research in that area. Admission to the Freshman Honors Program is limited and by invitation, and is based on past academic achievement, potential, and interest in an honors education.

Further information. Further information concerning the University Honors Program and the Freshman Honors Program can be obtained from the Honors Program Office in Osborn Cottage.

Inter-institutional Programs

Students have the opportunity to complete two years of study at another institution and the last two years at Iowa State through coordinated programs offered by the College of Family and Consumer Sciences.

Dual-degree Programs

Students who complete the first three years in certain curricula at Iowa State and who satisfactorily complete the first year in a recognized medical, dental, veterinary medical, or law curriculum may then be awarded a bachelor's degree from Iowa State. (See *Index, Preprofessional Study*.)

Iowa Lakeside Laboratory

Iowa Lakeside Laboratory is an off-campus teaching facility situated on a 140-acre campus on West Okoboji Lake in Northwest Iowa. It is run cooperatively by Iowa State University, the University of Iowa, and the University of Northern Iowa. Each summer Iowa State University students can take up to three undergraduate and/or graduate courses in archaeology, biology, ecology, environmental science, and/or geology for credit at Lakeside (see course listings under *Iowa Lakeside Laboratory*). All Lakeside courses are small, full-immersion, field-oriented courses that run for either 3 or 4 weeks. Lakeside also offers a variety of short courses for teachers and a series of non-technical short courses on various aspects of the natural history of Iowa. Information about Lakeside courses as well as registration and housing information can be obtained from the Administrative Office, Iowa Lakeside Laboratory, 131 Bessey Hall.

Gulf Coast Research Laboratory

Through an affiliation with Gulf Coast Research Laboratory (GCRL) at Ocean Springs, Mississippi, Iowa State University provides an opportunity for students the opportunity to take courses and do research relating to marine environments during the summer. Credit in taken at GCRL may be transferred

back to ISU degree programs. Brochures listing courses taught in a given summer at GCRL are available by writing or visiting 201 Bessey Hall. Information is also available from the GCRL web site at seahorse.ims.usm.edu/gindex.htm.

Federal Cooperative Education Program

Federal Cooperative Education combines classroom learning with paid work experience through either alternate (full-time) or parallel (concurrent, part-time) periods of work and study. In general, students under this program will require one year more to complete the usual curriculum requirements. Initial placement usually comes after completion of the first or second year. The student must observe regulations of the employer and not expect special treatment. University holidays do not apply to cooperative students, nor are students allowed time off for university activities. A student may not enroll in classes at any educational institution during a period of full-time cooperative employment without university approval. Those in a cooperative program are considered by the university to be students subject to university regulations concerning conduct during this period and are liable to dismissal from the university for misconduct on the job. They may continue living in university housing during work periods. Cooperative students pay no fees to the university during work periods, but may attend student activities provided they pay the activity fee.

The Washington Center Program

Iowa State University, in conjunction with The Washington Center, offers its students the opportunity to gain academic credit and first-hand professional work experience in the governmental, non-profit, and private sectors through a semester-long internship in the nation's capital. The Washington Center, the largest non-profit organization of its kind, places students in a variety of internships and also offers a wide array of academic programs and seminars to complement their internship experience. Further information about the requirements can be obtained from Career Services, 12 Alumni Hall, 515-294-9490.

Regent Universities Student Exchange Program

Iowa State University students may take courses at either of the other two Regent universities for Iowa State resident credit. Regular, degree-bound students in good standing at any of the three Regent universities may attend another Regent university for a maximum of two semesters, and the credits earned at the other university will be counted as resident credit at the home institution. Approval for participation and credit in the exchange program must be obtained well in advance of registration since the department head must approve the acceptance of such credits if these are to apply to the major, and to ensure complete processing of the application between the cooperating universities within specified dates for enrollment. Detailed information and application forms for the exchange program are available from the Office of the Registrar.

Study Abroad at ISU

In keeping with the university's international mission, ISU offers over 170 study abroad programs each year. Students in any major can study abroad on a semester, academic year, or short-term program. Faculty-led group programs, language and culture courses, Regent's semester programs, and academic exchanges are available in over 50 countries. In addition, ISU students may study abroad on other universities' organized programs or make independent arrangements to study abroad, arranging credit transfer approval in advance with the Office of Admission and the appropriate academic department(s). Over 800 students studied or worked abroad during 1998-99.

Most if not all financial aid at ISU can be applied to the cost of a student's program. In addition to the \$70,000 available for study abroad scholarships through the Study Abroad Center, a number of colleges also provide financial assistance. The university is committed to offering high-quality programs which are also affordable to students.

Increasingly, employers are anxious to hire students with international experience and foreign language ability. A study or work abroad experience can give students an edge in the market place and need not delay graduation.

Information about study abroad opportunities and requirements is available at the Study Abroad Center, Room 5 Hamilton Hall, 515-294-6792, or studyabroad@iastate.edu. See also individual department and college listings.

Study Abroad Exchange Programs

Students may spend a semester or academic year abroad while paying tuition and fees, and in some cases room and board at ISU. Select from over one hundred institutions in the following countries: Argentina; Australia; Austria; Brazil; Belgium; Canada; Colombia; Costa Rica; Côte d'Ivoire; Cyprus; Dominican Republic; England; Estonia; Fiji; Finland; France; Germany; Honduras; Hong Kong; Hungary; Italy; Kenya; Malta; Mexico; Netherlands; New Zealand; Philippines; Taiwan, ROC; Russia; Scotland; South Korea; Spain; Sweden; Switzerland; Tanzania; Thailand; Togo; Uruguay; Wales; and Zambia.

Study Abroad Language Programs

Four faculty-led programs (French, German, Spanish, and Russian) are offered each summer in France, Austria, Spain, and Russia, each lasting approximately eight weeks. Students may earn seven to twelve ISU credit hours while participating in an intensive language and cultural experience. The minimum requirement for enrollment in the programs is usually two years of university-level study or equivalent (e.g., four years of high school) of the appropriate language. An exception is the Russian program, which is sometimes open to lower-level students. Further information about requirements and specific courses can be obtained from the Department of Foreign Languages and Literatures.

Additional language programs abroad include a six-week intensive summer program for Spanish at ITESM, the Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM) in Mexico; a fall or spring semester program offering up to sixteen hours of ISU credit in Cuernavaca, Mexico; and academic year of intensive Chinese at the Mandarin Training Center in Taiwan; and a fall or spring semester program for intensive Spanish in Valladolid, Spain, just two hours north of Madrid. Most of the language programs provide students with the opportunity for maximum language and culture learning by living with a local family

Study Abroad Regents' Programs In Wales and Australia

In conjunction with the University of Iowa and the University of Northern Iowa, ISU offers a fall or spring semester program at the University of Wales, Swansea. Students on the program take a three-week course on British Culture and Politics and go on several field trips throughout Wales. In addition, students take 12-16 credits of regular classes at the university and live in university housing with British students. This program is Iowa State's most popular study abroad opportunity; up to 55 students enroll each semester. The program is based in Swansea, a vibrant Welsh city of 180,000. Swansea is near several national parks, the mountains, and the beach. London is only three hours away by train, and Swansea is also well connected to other parts of Britain and to Ireland.

The Iowa Regents' Universities also offer the popular Semester in Australia program at the University of Newcastle during both fall and spring semesters. This program is based in scenic Newcastle, Australia, a city of approximately 300,000 situated along the beach in New South Wales. After a week-long orientation, students on the program attend regular classes with Australian students. Students can earn up to 16 credit hours for their study in Newcastle and can choose to live in university residence halls or private apartments. The program provides two weekend field trips to nearby areas of interest, such as the Blue Mountains, Nelson Bay, or the Hunter Valley Wine Country. The Newcastle area offers students many things to do and see, and Sydney, only 100 miles away, is easily reached by train or car.

Internships

A limited number of paid internships are available through the Study Abroad Center for students majoring in engineering, natural and physical sciences, business, agriculture, and forestry.

Financial and Credit Transfer

With the exception of college work study, students may apply their financial aid to the cost of studying abroad. Scholarships are also available for certain programs. Further, transfer credit earned while abroad may still fulfill graduation requirements and, with careful planning, students should not have their graduation delayed.

Note: A number of programs assess a fee to cover administrative costs associated with the program. For information on these fees and program costs, please consult the Study Abroad Center or relevant department.

Military Training

Iowa State University students may elect to participate in one of the Reserve Officers Training Programs (ROTC) offered at Iowa State by the Army, the Navy, and the Air Force. Descriptions of the specific programs are found under the departments of Air Force Aerospace Studies, Military Science, and Naval Science. A student who completes a four-year program in any of these fields may be commissioned as a military officer at the time of graduation.

Late Afternoon, Evening, and Saturday Classes

In order to make on-campus courses available to those who live within commuting distance of Ames, classes are scheduled in the late afternoon and evening so that persons with full-time employment or other responsibilities may commute and continue their education. The university publishes a brochure announcing these courses each semester, which may be obtained by writing or calling the Office of Admissions, Alumni Hall, Iowa State University, Ames, Iowa 50011.



David G. Topel, Dean
www.ag.iastate.edu

Departments of the College

Agricultural Education and Studies
Agricultural and Biosystems Engineering
Agronomy
Animal Ecology
Animal Science
Biochemistry, Biophysics, and Molecular Biology
Economics
Entomology
Food Science and Human Nutrition
Forestry
Horticulture
Microbiology
Plant Pathology
Sociology
Zoology and Genetics

Students enrolled in the College of Agriculture are provided a broad-based education that includes coursework in communications; biological, physical, and social sciences; humanities; and technical subject matter.

Upon graduation students find diverse career opportunities because of the well balanced education they have received as undergraduates. Opportunities for graduates include production agriculture, business and industry, public agencies, education, biological and environmental sciences, value-added processing, natural resource management, rural development, animal and human health professions, and graduate studies.

High School Preparation

Requirements for students entering from high school or transferring with less than 24 college credits into the College of Agriculture include four years of English; three years of mathematics which must include one year each of algebra, geometry, and advanced algebra; three years of science which must include one year each of biology and chemistry, or biology and physics, or chemistry and physics; and two years of social studies. No foreign language is required for admission to the College of Agriculture.

Majors in the College of Agriculture

A student has many majors from which to choose. Each major is unique but there are courses common to many. This is helpful to students in that they may transfer from one agriculture major to another before the second year with little, if any, loss of credits. Options and areas of specialization further define the majors and required coursework within some majors. In all cases, majors are designed to help students succeed in their chosen professions. Majors in agriculture are:

Primary Majors

Agricultural Biochemistry
Agricultural Business
Agricultural Education
Agricultural Studies
Agricultural Systems Technology
Agronomy
Animal Ecology
Animal Science
Dairy Science
Dietetics
Entomology
Environmental Science
Food Science
Forestry
Genetics
Horticulture
Microbiology
Nutritional Science
Plant Health and Protection
Professional Agriculture (off-campus)
Public Service and Administration in Agriculture
Zoology

Secondary Majors

Agricultural Extension Education
Environmental Studies
International Agriculture
Pest Management
Seed Science

A secondary major must be taken in conjunction with a primary major.

Minors

Agricultural Biochemistry
Agricultural Education and Studies
Agricultural Systems Technology
Agronomy
Animal Ecology
Entomology
Environmental Science
Environmental Studies
Food Science
Forestry
Genetics
Horticulture
International Agriculture
Microbiology
Nutrition
Pest Management
Plant Health and Protection
Zoology

See statement on *minors* in the *Colleges and Curricula* section of this catalog.

Special Programs General Agriculture

General Agriculture is a starting place for students who wish to pursue careers in agriculture but who are unsure of which majors to choose. The Agriculture Student Services Office provides advising for general agriculture students until they select their majors.

Preveterinary Medicine

Students in the College of Agriculture may complete the requirements for admission to the College of Veterinary Medicine by enrolling in any major within the college. Because a solid foundation in the sciences is basic to the program in veterinary medicine, those majors that emphasize the sciences are usually more compatible with preveterinary medicine (see College of Veterinary Medicine section of this catalog for specific admissions requirements).

Students who are undecided about choice of major may enroll in general preveterinary studies (Gen PV). These students will also enroll in an orientation course, which describes the various college majors. A Gen PV student has up to 1.5 semesters to select a major.

Preveterinary medicine students also have an opportunity, with careful planning, to complete the requirements for a bachelor of science degree in an individual curriculum within the College of Agriculture after admission to the College of Veterinary Medicine. This may be done by completing the prescribed course of study established by an individual major. Students also may meet degree requirements of an individual major through the College of Agriculture Honors Program. Further details are available from an academic adviser or from members of the College of Agriculture Honors Committee.

Honors Program

The College of Agriculture Honors Program provides an opportunity for students of high ability to maximize their educational experience by individualizing their program of study. (See statement on *Honors Program* in the *Colleges and Curricula* section of this catalog). For more information, contact the chair of the College of Agriculture Honors Committee, or your department Honors contact person.



Off-Campus Programs

Coursework leading to bachelor of science and master of agriculture degrees in professional agriculture and a nonthesis master of science in microbiology are offered to students who choose to study off-campus; see *Extended and Continuing Education* for further information.

Study Abroad and International Travel Opportunities

Agriculture is being transformed into a highly interconnected global system; decisions made in one agricultural sector have profound impacts worldwide. It is important for students to develop an understanding and appreciation for the global system and the central role that U.S. agriculture plays in providing a safe and predictable food supply for a growing world population. The College of Agriculture provides study abroad and international travel opportunities in several locations around the world. For additional information, contact the Office of International Agriculture Programs in the College of Agriculture.

Internships and Cooperative Education Programs

Practical work experience can provide a unique learning opportunity that complements academic coursework. This experience is provided through internships or cooperative education programs. For additional information, contact a departmental adviser or internship coordinator.

College of Agriculture Core Curriculum and Electives

All curricula in the College of Agriculture lead to a bachelor of science degree. Each major has specific degree requirements for graduation. These include the College of Agriculture's core curriculum.

Students pursuing a primary major in another college and taking a second major in the College of Agriculture must fulfill the core curriculum requirements of the College of Agriculture and all the requirements of the second major. The College of Agriculture core curriculum follows.

Minimum Credits	Subject Area
9.5	Interpersonal and public communication skills 6 credits of English with grades of C or better in both required core English courses (104 and 105); 3 credits of speech fundamentals with grades of C or better; 0.5 credit in Lib 160
17	Mathematical, physical, and life sciences 3 credits of mathematics; 3 credits of statistics; 5 credits of physical science (e.g., chemistry, geological and atmospheric sciences, physics); 6 credits of life science (e.g., biochemistry, biology, botany, ecology, genetics, microbiology, physiology, zoology).

15 Humanities, ethics and social sciences

3 credits of ethics from an approved list; 3 credits of humanities; 3 credits of social sciences; 3 credits of U.S. diversity from an approved list; 3 credits of international perspectives from an approved list.

The College of Agriculture is committed to enhancing student proficiency in four areas:

1) ability to write, discuss and present subject matter within the major (communications), 2) ability to consider many dimensions of a problem and develop a solution (problem-solving), 3) ability to use computers for computation, document processing and communications, and 4) ability to analyze issues related to human impact on natural resources and the environment. Courses required by each major, courses within the College of Agriculture's core curriculum or free elective courses are used to develop these proficiencies. The specific requirements are:

Communications: Equivalent to 3 credits from one or more courses. Communication activities are incorporated into designated courses within each major field. The requirement is fulfilled by taking one or more of these communication-intensive courses.

Problem-solving: Equivalent to 3 credits from one or more courses. Problem-solving activities (disciplinary and multidisciplinary) are incorporated into designated courses within each major field. The problem-solving requirement is fulfilled by taking one or more of these problem-solving-intensive courses.

Computer proficiency: All College of Agriculture students must demonstrate computer proficiency according to procedures established by each department.

Environmental issues: Equivalent to 3 credits from one or more courses. Students are strongly encouraged to select course work in this area which will give them an appreciation of both ecological and human/societal dimensions of the environment.

Electives

Students use electives to broaden their education or to strengthen an area of specialization. Electives may be used to meet the requirements for a double major (see statement on double majors in this catalog). Those who wish to change their major, or who decide to graduate with a double major, must be enrolled for the last two semesters in the curriculum in which they expect to graduate. Students in ROTC may apply ROTC credits toward elective requirements.

Advising

Each student in the College of Agriculture works closely with an academic adviser who is associated with the major in which the student is enrolled. All entering students and their parents are strongly encouraged to participate in the summer orientation program in which they will have the opportunity to meet and work with academic advisers in planning their first semester schedule of classes. The advisers also assist students in making personal adjustments to university life, offer suggestions on

academic and co-curricular choices, and provide information on career choices. Advisers make a special effort to adjust course schedules in accordance with students' interests and capabilities.

A student may wish to prepare for admission to a professional program such as law, medicine, or veterinary medicine while pursuing a bachelor of science degree in the College of Agriculture. This may be accomplished through several majors; however, it is recommended that the student work closely with an academic adviser.

Each department prepares a guide to help students chart their long-term programs and to specify the exact requirements for graduation.

Visit the college web site www.ag.iastate.edu.

Graduate Study

Graduate study in agriculture is conducted through the Graduate College. Details are found in the Graduate College section of this catalog.

Various departments in the College of Agriculture also participate in the following graduate-level interdepartmental offerings:

Ecology and Evolutionary Biology
Genetics
Immunobiology
Molecular, Cellular, and Developmental Biology
Neuroscience
Plant Physiology
Professional Agriculture (off-campus)
Technology and Social Change (interdepartmental minor)
Toxicology
Water Resources

For details, consult the Graduate College section of this catalog.

Curriculum in Agricultural Biochemistry

Administered by the Department of Biochemistry, Biophysics and Molecular Biology.

Cr. Degree Requirements

9.5 **Interpersonal and public communication skills**
Engl 104, 105; Sp Cm 212; Lib 160

62-63 **Mathematical, physical, and life sciences**
Math 165, 166, 265 or 266; Phys 221, 222; Chem 177, 177L, 178, 210 or 211, 211L, 321, 322, 322L, 331, 331L, 332; Biol 201, 202, 201L or 202L, 301, 302

- 15 Humanities, ethics, and social science
3 cr. in ethics from an approved list; 3 cr. in humanities; 3 cr. in social sciences; 3 cr. in U.S. diversity from an approved list; 3 cr. in international perspectives from an approved list
- 9 Agricultural sciences
9 cr. from an approved list available in the department. Two courses with environmental awareness emphasis will be chosen from an approved list.
- 11-13 Agricultural biochemistry
BBMB 101, 102; 404, 405 or 501, 502; 411. Students wishing research experience in agricultural biochemistry are encouraged to enroll in BBMB 499

21.5-22.5 Electives

128 Total credits

Typical Program for the First Year

Cr. Fall

- 4 General Chemistry—Chem 177M
- 1 Laboratory in General Chemistry—177N
- 4 Calculus I—Math 165
- 3 First-Year Composition—Engl 104
- 3 Principles of Biology—Biol 201
- 1 Principles of Biology Laboratory—Biol 201L
- 1 Introduction to Biochemical Activities—BBMB 101

Cr. Spring

- 3 General Chemistry—Chem 178
- 4 Calculus II—Math 166
- 3 First-Year Composition—Engl 105
- 3 Principles of Biology—Biol 202
- 1 Principles of Biology Laboratory—Biol 202L
- 1 Introduction to Biochemistry—BBMB 102

Curriculum in Agricultural Business

Administered by the Department of Economics. Students majoring in Agricultural Business often choose elective coursework leading to minors in the College of Business or in the College of Agriculture, or emphasizing specific areas within agricultural business such as finance, management, commodity analysis, research, agricultural sales and marketing, environmental economics, farm and ranch operations, appraisal, agricultural extension, or government service.

Cr. Degree Requirements

- 12.5 Interpersonal and public communication skills
Lib 160, Engl 104, 105, 302; Sp Cm 212

- 15 Mathematical and computer science
Math 150, 151; Stat 227; Com S 103
- 5 Physical Sciences
Chem 163-163L
Phys 111
- 6 Life and Environmental Sciences
Biol 109 or 201
A Ecl 120
or
Biol 123 or other credits that meet the environmental intensive requirement
- 12 Humanities, ethics and social science
Courses in individual areas below may overlap but the total credits taken must equal 12 or more
Ethics
International perspectives
U.S. diversity
Humanities
Social science other than economics
- 9 Business
Acct 284, 285; Fin 350
- 3 Agricultural sciences electives
- 35 Economics and Agricultural Economics
Econ 101, 101L, 102, 110, 135, 301, 302 or 353, 330, 335, 451, 460
One of the following:
Econ 432, 437, 455, 466, 472, 480
Economics at the 300 level or above
Econ 492
- 30.5 Free electives
- 128 Total credits

Typical Program for the First Year

Cr. Fall

- 3 Microeconomics—Econ 101
- R Orientation in Economics/Agricultural Business—Econ 110
- 3 Agricultural Science Course
- 3 Mathematics for Business and Social Sciences I —Math 150
- 3 First-Year Composition—Engl 104
- 3 Rural Institutions and Organizations—Soc 130

Cr. Spring

- 3 Introductory Biology—Biol 109
- 3 Agribusiness Firms, Markets and Prices—Econ 135 or Financial Accounting—Acct 284
- 3 Mathematics for Business and Social Sciences II—Math 151
- 3 First-Year Composition—Engl 105
- 3 Macroeconomics—Econ 102

Curriculum in Agricultural Education

Administered by the Department of Agricultural Education and Studies. Students majoring in Agricultural Education choose between two options: Teacher Certification or Communications.

Teacher Certification Option

Cr. Degree Requirements

- 9.5 Interpersonal and public communication skills
Engl 104, 105, Lib 160, AgEds 311 (3 cr.); communications intensive requirement.
- 21-22 Mathematical, physical, and life sciences
Chem 163, 163L or 177, 177L; Stat 104; Biol 201, 201L; Biol 202, 202L; or BMBB 221; Math 104 or 150; life science elective (3 cr.); demonstration of computer proficiency; environmental intensive requirement
- 18 Humanities, ethics, and social sciences
Psych 230, 333; American history elective (3 cr.); from approved lists: 3 cr. in ethics; 3 cr. in international perspectives; 3 cr. in U.S. diversity; problem-solving intensive requirement
- 1 Physical education
Elective selected from PE, dance, health, and/or safety
- 27 Agricultural sciences and economics
Agron 114; An S 114 and 114L; AST electives (4 cr.); horticulture elective (2 cr.); Econ 101 and 330; Acct 284; 6 credits in courses 300-level or above to be chosen from agricultural systems technology, animal science, agronomy, agricultural economics, forestry, or horticulture; electives from the College of Agriculture (3 cr.)
- 33.5 Professional credits
For certification: AgEds 110A, 211, 310, 410, 411, 416, 417 (12 Cr.); C I 201, 204, 406, 415, 426. For noncertification: AgEds 110, 310, 315, 410, 411, 412 (4 cr.), 414, 418 (4 cr.); ComSt 214 or 314; electives from AgEds, C I, Soc, ComSt, Sp Cm, Econ 341 (8 cr.).
- 17-18 Electives

Communications Option

Cr. Degree Requirements

- 9.5 Interpersonal and public communication skills—Engl 104, 105, Lib 160, speech elective (3 cr.), communication intensive requirement
- 23-24 **Mathematical, physical, and life sciences**—Chem 163, 163L or 177, 177L; Biol 201, 202; BMBB 221 or Phys 106; life science elective (3 cr.); demonstration or computer proficiency; Math 140 or 150; Stat 104; environmental intensive requirement
- 15 **Humanities, ethics, and social sciences**—Econ 101 or 102; psychology elective (3 cr.); ethics elective (3 cr.); international perspectives elective (3 cr.); U.S. diversity elective (3 cr.); problem-solving intensive requirement.
- 26 **Agricultural sciences and economics**—10 credits in a selected area of agricultural sciences and economics including 6 credits at the 300-400 level; 6 cr. each in two additional areas of agricultural sciences and economics; agricultural sciences and economics electives (4 cr.)
- 41.5 **Professional communications**—AgEds 110A, 211, 215, 311, 315, 412 (6 cr.); select 27 cr. from JI MC 101, 102, 320, 321, 342, 347, Engl 205, 309, 310, 314, 415, 416, Mgmt 370, 371, Sp Cm 110, 212, 312, 323, 327, ComSt 102, 214, 310, 314, 317, 318, 414

12-13 Electives

128 Total credits

Typical Program for the First Year

Cr.	Fall
3	First-Year Composition—Engl 104
3	Fundamentals of Algebra for Science and Higher Mathematics—Math 140
3	Principles of Micro Economics—Econ 101
3	Speech elective
3	Psychology elective
0.5	Library Instruction—Lib 160
Cr.	Spring
3	First-Year Composition—Engl 105
3	Principles of Crop Production—Agron 114
3	Instructional Technology—C I 201
2	Agriculture elective
3	Principles of Biology—Biol 201, 201L

Curriculum in Agricultural Extension Education

Administered by the Department of Agricultural Education and Studies. Agricultural extension education may be taken only as a secondary major in a double major program.

Cr. Degree Requirements

- 12.5 **Interpersonal and public communication skills**
Engl 104, 105, written communications elective (3 cr.); AgEds 311; Lib 160; communications intensive requirement
- 20 **Mathematical, physical and life sciences**
Chem 163, 163L or 177, 177L; Math 104 or 150; Stat 104; Biol 201; entomology elective (3 cr.); life sciences elective (3 cr.); environmental intensive requirement; demonstration of computer proficiency
- 18 **Humanities, ethics, and social sciences**
Psychology elective (3 cr.); from approved lists: 3 cr. in ethics, 3 cr. in international perspectives; 3 cr. in U.S. diversity; humanities electives (6 cr.); problem-solving intensive requirement
- 35 **Agricultural sciences and economics**
Animal science electives (6 cr.); agronomy electives (9 cr.); economics elective (3 cr.); horticulture elective (2 cr.); electives (15 cr.)
- 14.5 **Professional credits**
AgEdS 110A, 211, 310, 311, 315, 414, 418 (8 cr.)
- 28 **Electives**
- 128 **Total credits**

Typical Program for the First Year

Because agricultural extension education is a secondary major that has requirements that are similar to those of the agricultural education major, courses taken by the student during the first year will be similar to those taken by first-year agricultural education majors. Differences in individual programs will reflect the student's choice of a primary major.

Curriculum in Agricultural Studies

Administered by the Department of Agricultural Education and Studies. Students are encouraged to develop one or more areas of concentration in agricultural sciences and economics.

Cr. Degree Requirements

- 12.5 **Interpersonal and public communication skills**
Engl 104, 105; written communications elective (3 cr.); speech elective (3 cr.); Lib 160; communications intensive requirement.
- 20 **Mathematical, physical, and life sciences**
Chem 163, 163L or 177, 177L; Math 104 or 150; Stat 104; Biol 109 or 201; life science elective (6 cr.); demonstration of computer proficiency; environmental intensive requirement.
- 18 **Humanities, ethics, and social sciences**
Econ 101; humanities electives (3 cr.); AgEdS 315; from approved lists: 3 cr. in ethics; 3 cr. in international perspectives; 3 cr. in U.S. diversity; problem-solving intensive requirement.
- 42.5 **Agricultural sciences and economics**
AgEdS 110B, 215, 450; Agron 114, 154, 212; An S 114 and 114L, electives (6 cr.); Econ 135, 330; AST electives (4 cr.); agricultural sciences and economics electives (9 cr.), 300-400 level.

Other required courses

- 3 Acct 284
- 32 Electives
- 128 Total credits

Typical Program for the First Year

Cr.	Fall
0.5	Orientation to Agricultural Studies—AgEdS 110B
3	Survey of the Animal Industry—An S 114 and 114L
3	Introduction to Probability and Matrices—Math 104 or Discrete Mathematics—Math 150
3	First-Year Composition—Engl 104
3	Social science elective
3	Introductory Biology—Biol 109
0.5	Library Instruction—Lib 160
Cr.	Spring
3	Principles of Crop Production—Agron 114
3	Principles of Microeconomics—Econ 101
3	Life science elective
3	Humanities elective
3	First-Year Composition—Engl 105

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the agricultural studies curriculum.

Curriculum in Agricultural Systems Technology

Administered by the Department of Agricultural and Biosystems Engineering. A minor in agricultural systems technology is available; the requirements appear under Agricultural Systems Technology, Courses and Programs.

Systems Technology and Management Option

Cr.	Degree Requirements
12.5	Interpersonal and public communication skills Engl 104, 105; Sp Cm 212 or AgEdS 311; Engl 302 or 309 or 314; Lib 160
28-30	Mathematical, physical, and life sciences Math 160 or 165 or 140 and 142 or 151; Stat 104; Chem 163, 163L; Phys 106 or 111; AST 181, 281; Biol 109; BBMB 221 or Biol 123 or A Ecl 120
15	Humanities, ethics, and social sciences Humanities elective (3 cr.); Econ 101; from approved lists: 3 cr. in ethics, 3 cr. in international perspectives; 3 cr. of U.S. diversity; and environmental-intensive requirement
6	Agricultural sciences Select from department-approved list
29.5	Agricultural systems technology AST 110, 403, 496; a minimum of 25 cr. from the following: AST 191, 233, 260, 290, 297, 324, 326, 330, 333, 335, 337, 358, 360, 362, 425, 430, 435, 460, 464, 473, 475, 476, 490; and problem solving-intensive requirement
6	Other required courses Acct 284; Econ 330 or Mgmt 370 or Econ 336
18	Areas of specialization Production Agriculture: Credits selected from department-approved list of agricultural science courses Agribusiness Management: Credits selected from department-approved list Grain Operations: Acct 285; AST 464; Econ 135; Mkt 340; a minimum of 7 credits from the following: An S 319; Econ 301, 332, 335; Ent 376; Mgmt 371; TrLog 360, 460 Applied Technology: Select credits with adviser assistance for specialization in one of these areas: water quality, safety, seed science, construction technology, machine testing, food processing, environment, computer operations, international studies, industrial technology

11-13 Free electives

128 Total credits

Environmental Systems Technology Option

Cr.	Degree Requirements
12.5	Interpersonal and public communication skills Engl 104, 105; Sp Cm 212 or AgEdS 311; Engl 302 or 309 or 314; Lib 160
40-42	Mathematical, physical, and life sciences Math 160 or 165 or 140 and 142; Stat 104; Chem 163, 163L, 164, 231, 231L; Phys 106 or 111; AST 181, 281; Biol 201, 201L, 202, 202L; Micro 201, 201L
15	Humanities, ethics, and social sciences Econ 101; Hist 472; from approved lists: 3 cr. in ethics, 3 cr. in international perspectives; 3 cr. of U.S. diversity; and environmental-intensive requirement
12	Agronomic sciences Select a minimum of 12 credits from Agron 114, 154, 206, 260, 317, 354, 356, 360, 485
14	Environmental Sciences Select a minimum of 14 credits from A Ecl 410, 513; Biol 312; Bot 330, 487, 500, 564; Env S 123, 324, EnSci 401, 402, 404; For 407
6	Environmental Studies Select a minimum of 6 credits from: Env S 201, 293, 340, 380, 382, 450, 482, 491
20.5	Agricultural systems technology AST 110, 120, 324, 326, 333, 403, 425, 475, 496. Select a minimum of 12 credits from 191, 233, 297, 360, 435, 460, 473, 490; and problem solving-intensive requirement
6-8	Free electives
128	Total credits

Mechanical Systems Option

Cr.	Degree Requirements
12.5	Interpersonal and public communication skills Engl 104, 105; Engl 302 or 309 or 314; Sp Cm 212 or AgEdS 311; Lib 160
28-31	Mathematical, physical, and life sciences Stat 104 or 101; Math 140 and 142 or 160 or 165; Chem 163, 163L; Phys 106 or 111; AST 181, 281; Biol 109; Biol 123 or A Ecl 120
15	Humanities, ethics, and social sciences Econ 101; humanities elective (3 cr.); from approved lists: 3 cr. in ethics, 3 cr. in international perspectives; 3 cr. of U.S. diversity; and environmental-intensive requirement

6 Agronomic sciences

Agron 114, 154

31.5 **Agricultural systems technology**
AST 110, 330, 333, 335, 337, 360, 403, 430, 435, 460, 496; a minimum of 5 credits from the following: AST 191, 233, 260, 297, 358, 362, 464, 473, 475, 490; problem-solving intensive requirement

24 **Areas of specialization**

Management: Acct 284; Econ 336; Mgmt 370; Mkt 340; a minimum of 12 credits from the following: Acct 215, 285, 316; I Tec 231, 244, 360; Mgmt 371; MIS 330; Mkt 442, 446, 447

Precision Agriculture: Credits selected from departmental-approved list.

Technology: Math 166, E M 274, 324, 327; Phys 112; a minimum of 9 credits from the following: E M 378, 417; I Tec 231, 244, 360; Mat E 362, 362L, Stat 401

8-11 Free electives

128 Total credits

Typical Program for the First Year

Cr.	Fall	Spring
0.5	Orientation in Agricultural Systems Technology—AST 110	
2	Principles of Agricultural Systems Technology—AST 191	
3	Fundamentals of Algebra—Math 140	
3	First-Year Composition—Engl 104	
5	General Chemistry—Chem 163, 163L	
3	Agricultural science elective	
3	Microcomputer Applications in Agriculture—AST 181	
3	Introductory Biology—Biol 109 or Principles of Biology—Biol 201	
3	First-Year Composition—Engl 105	
3	Trigonometry and Analytic Geometry—Math 142 or Calculus for Business and Social Sciences—Math 151	
3	Agricultural science elective	
0.5	Library Instruction—Lib 160	

Curriculum in Agronomy

Students majoring in agronomy study crop science, soil science, and agricultural meteorology in one of three options: (1) general agronomy, (2) environmental science, (3) science.

General Agronomy Option

Cr.	Degree Requirements
12.5	Interpersonal and public communication skills Engl 104, 105; Lib 160; Sp Cm 212 or AgEdS 311; Engl 302 or 314; communications-intensive requirement
6	Mathematical sciences Math 140; Stat 104; demonstration of computer proficiency

- 16 **Physical sciences**
Chem 163, 163L, 231, 231L, Geol 100; Phys 106
- 16 **Biological sciences**
Biol 201, 201L, 202, 202L; Agron 320; select two additional courses from Biol 312; BBMB 301; Ent 376; Micro 201, or PI P 407
- 15 **Humanities, ethics, and social science**
3 cr. each in ethics, U.S. diversity, and international perspectives (from approved lists); must include a minimum of 3 cr. in humanities and 3 cr. in social sciences (may be courses on approved lists or other equivalent courses); environmental intensive requirement; problem-solving intensive requirement
- 6 **Economics and business**
Econ 101; one course from the following: Acct 284, Econ 102, 135, 330, 336, Mgmt 370, Mkt 340
- 33 **Agronomic sciences**
Agron 105, 110, 114, 154, 206, 210, 230, 306, 310, 354, 354L, 392, 410, and 492 and 9 cr. of electives (no more than 2 cr. total from Agron 331, 370, 490, 491, and 496 allowed to meet the 9 cr. requirement; Agron 320 may be used only as a biological science by Agronomy majors) (A minimum of 15 credits in agronomy must be earned at Iowa State.)
- 23.5 **Free electives**
- 128 **Total credits**

Environmental Science Option

- Cr. Degree Requirements**
- 12.5 **Interpersonal and public communication skills**
Engl 104, 105; Lib 160; Sp Cm 212 or AgEdS 311; 3 cr. elective from approved list; communication-intensive requirement
- 6 **Mathematical sciences**
Math 140; Stat 101 or 104; demonstration of computer proficiency
- 17 **Physical sciences**
Chem 163, 163L, 231, 231L; Geol 100, 100L; Phys 106
- 13 **Biological sciences**
Biol 201, 201L, 202, 202L; Micro 201; 3 cr. from the following: A Ecl 410, Agron 320, Biol 312, BBMB 301, Ent 376, PI P 407
- 15 **Humanities, ethics, and social science**
3 cr. each in ethics, U.S. diversity, and international perspectives (from approved lists); must include a minimum of 3 cr. in humanities and 3 cr. in social sciences (may be courses on approved lists or other equivalent courses); environmental intensive requirement; problem-solving intensive requirement

- 6 **Economics and business**
Econ 101; Env S 380
- 31 **Agronomic sciences**
Agron 105, 110, 114, 154, 206, 210, 260, 310, 360, 410, 473, 485, 492 and 5 cr. of electives (no more than 2 cr. total from Agron 331, 370, 490, 491, and 496 allowed to meet the 5 cr. requirement) (A minimum of 15 cr. in agronomy must be earned at Iowa State.)
- 9 **Environmental sciences**
Select 9 credits from Env S 201, 293, 324, 330, 425, 450, 491; EnSci 401, 402, 404; AST 425, 475
- 18.5 **Free electives**
- 128 **Total credits**

Science Option

The science option is recommended for individuals who want a stronger basic science orientation. See an agronomy adviser for specific recommendations.

Typical Program for the First Year

Cr.	Fall
R	Orientation in Agronomy—Agron 110
3	Introduction to Meteorology—Agron 206
3	Principles of Crop Production—Agron 114
3	Fundamentals of Algebra for Science and Higher Mathematics—Math 140
3	First-Year Composition—Engl 104
4	Principles of Biology I—Biol 201 and 201L
0.5	Library Instruction—Lib 160
Cr.	Spring
3	Fundamentals of Soil Science—Agron 154
5	General Chemistry—Chem 163 and 163L
3	First-Year Composition—Engl 105
3	The Earth—Geol 100
3	Principles of Microeconomics—Econ 101

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the agronomy curriculum.

Curriculum in Animal Ecology

- Cr. Degree Requirements**
- 15.5 **Interpersonal and public communication skills**
Engl 104 and 105; Sp Cm 212; Lib 160; two additional 3-cr. courses in written or oral communication from an approved list; and communications-intensive requirement
- 10-13 **Mathematical sciences**
Math 140 and 141, or 142 or 149; 160 or 165 or 181; Stat 101 or 104

- 3-4 **Computer science or computer applications**
AST 181 or Com S 103
- 16 **Physical sciences**
Chem 163, 163L, 164 (or 177, 177L, 178); 231, 231L; Phys 106
- 21 **Biological sciences**
A Ecl 110, 120, 211, 310, 311, 312; Biol 201, 201L, 202, 202L
- 15 **Humanities, ethics, and social science**
3 cr. in humanities; 3 cr. in social sciences; from approved lists: 3 cr. in ethics, 3 cr. in U.S. diversity, and 3 cr. in international perspectives; and environmental-intensive and problem-solving intensive requirements
- R **Practical experience requirement**
(A Ecl 104)

Students majoring in Animal Ecology are required to choose one of the following options by the end of their sophomore year: Aquaculture, Ecology, Fisheries, Interpretation of Natural Resources, Preveterinary and Wildlife Care, or Wildlife.

Options

- Cr.**
- 27 **Aquaculture**
A Ecl 321, 410, 410L, 442; An S 319; Bot 364; Biol 301 or Gen 320; one course from Acct 284, Econ 101, Mkt 340, 341; 6 credits from approved list.
- 27 **Ecology**
A Ecl 413; Biol 303; Bot 484; Gen 320; one course from A Ecl 425, 515, Bot 306, 356, 505, Ent 370; one course from Agron 154, 206, Geol 100, 101; one course from Com S 207, Math 166, 182, Stat 401; remaining credits to complete 27 total from approved lists.
- 27 **Fisheries**
A Ecl 321, 410, 410L, 440, Bot 364; 15 credits from approved list.
- 27 **Interpretation of Natural Resources**
A Ecl 325, 330, 430; Bot 306, Ent 370; one course from Bot 356, 36, and 484; one course from Agron 154, 206, Astro 120, Geol 100, 101; 7 credits from approved list.
- 27 **Preveterinary and Wildlife Care**
A Ecl 330, 350; An S 214, 336; one course from BMS 415 and 416, Zool 320, 322, 454; one course from An S 331, 352, Biol 301, Gen 320, Zool 334 and 334L; one course from A Ecl 442, An S 319, AST 473, Micro 201 and 201L, Zool 311; 3 credits of A Ecl coursework at 300 level or above; remaining credits to complete 27 total from approved lists

- 27 **Wildlife**
A Ecl 350, 451; 6 credits from management group list; two courses from ecology/biology group list; one course from Bot 306, 356, 364, Agron 317; one course from Econ 101, 102, Pol S 215; additional credits from management, ecology/biology, plant taxonomy group lists to complete 27 total credits

15.5-20.5 **Free electives**

128 **Total Credits**

Typical Program for the First Year

- Cr. Fall**
4 Principles of Biology—Biol 201, 201L
R Orientation in Animal Ecology—A Ecl 110
3 First-Year Composition—Engl 104
3 College Algebra—Math 140
5 General Chemistry—Chem 163, 163L
Cr. Spring
4 Principles of Biology—Biol 202, 202L
3 Introduction to Renewable Resources—A Ecl 120
3 First-Year Composition—Engl 105
0.5 Library Instruction—Lib 160
2 Trigonometry—Math 141
3 General Chemistry - Chem 164

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the animal ecology curriculum. The Preveterinary and Wildlife Care option has been designed for this purpose.

Curriculum in Animal Science

- Cr. Degree Requirements**
12.5 **Interpersonal and public communication skills**
Engl 104, 105, 302 or 314; Sp Cm 212; Lib 160; and communications-intensive requirement*
6-8 **Mathematical sciences**
Math 150; Stat 101 or 104 or 227
8 **Physical sciences**
Chem 177, 177L; BBMB 221 or Chem 231 or Chem 331
14 **Biological sciences**
Biol 201, 201L; 202, 202L or B M S 329; Biol 301 or Gen 320; 3 credits Microbiology, including laboratory; and an environmental-intensive requirement

- 15 **Personal development, human relations, and global awareness**
a minimum of: 3 credits in humanities; 3 cr. in social sciences; from approved lists : 3 cr. in ethics, 3 cr. in international awareness, 3 credits in U.S. multicultural awareness; and problem solving-intensive requirement

- 29-31 **Animal science**
An S 110; 114, 114L; 211; 214; 214L, 311; 411; one course from: 216, 224, 250, 270; 319; 331; 352; one course from 313, 336, 337, 345, 360; two courses from: 415, 419, 423, 424, 425, 426, 429, 434, 451, 470, FS HN 405, 410
A minimum of 15 credits in this category must be earned from courses taught in the Animal Science department at ISU.

- 3-7 **Business**
Com S 103 or proficiency exam or AST 181, one course from department list

32.5-40.5 **Free electives**

128 **Total credits**

A minimum of 15 credits in this category must be earned from courses taught in the Animal Science Department at Iowa State University.

Typical Program for the First Year

- Cr. Fall**
R Orientation in Animal Science—An S 110
2 Survey of the Animal Industry—An S 114
1 Working with Animals—An S 114L
3 Principles of Biology—Biol 201
1 Principles of Biology Lab—Biol 201L
3 First-Year Composition—Engl 104
0.5 Library Instruction—Lib 160
3 Mathematics—Math 150
3 Elective

- Cr. Spring**
4 General Chemistry—Chem 177
1 General Chemistry Lab—Chem 177L
3 First-Year Composition—Engl 105
3 Introduction to Statistics—Stat 104
3 Humanities elective
3 Elective

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the animal science curriculum.

Curriculum in Dairy Science

- Cr. Degree Requirements**
9.5 **Interpersonal and public communication skills**
Engl 104, 105; Sp Cm 212 or AgEds 311; Lib 160; and communications intensive requirement
9-13 **Mathematical and business sciences**
AST 181 or Com S 103 or proficiency exam; Econ 101; Math 150; Stat (3 cr.)
8 **Physical sciences**
Chem 177, 177L; BBMB 221 or Chem 231 or 331
10-11 **Biological sciences**
Biol 201, 201L; Biol 301 or Gen 320; Micro 201 and 201L or FS HN 273; and environmental-intensive requirement
15 **Personal development, human relations, and global awareness**
3 cr. in humanities ; 3 cr. in social sciences; from approved lists: 3 cr. in ethics, 3 cr. in international awareness, 3 cr. in U.S. multicultural awareness; and problem solving-intensive requirement
28 **Professional dairy science**
An S 110, 114, 114L, 211, 214, 214L, 311, 319, 331, 337, 352, 411, 434, plus a minimum of 6 credits from list maintained in department. A minimum of 15 credits in this category must be earned from courses taught in the Animal Science department at ISU.
43.5-48.5 **Free electives**
128 **Total Credits**

A minimum of 15 credits in this category must be earned from courses taught in the Animal Science Department at Iowa State University.

Typical Program for the First Year

- Cr. Fall**
R Orientation in Dairy Science—An S 110
3 Survey or the Animal Industry—An S 114, 114L
3 Principles of Biology—Biol 201
1 Principles of Biology Lab—Biol 201L
3 First-Year Composition—Engl 104
0.5 Library Instruction—Lib 160
3 Mathematics—Math 150
3 Elective
Cr. Spring
3 AST 181
4 General Chemistry—Chem 177
1 General Chemistry Lab—Chem 177L
3 First-Year Composition—Engl 105
3 Introduction to Statistics—Stat 104
3 Elective

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the dairy science curriculum.

Curriculum in Dietetics

Administered by the Department of Food Science and Human Nutrition.

General Dietetics

The student is prepared for admission to dietetic internship programs and other professional experience programs approved/accredited by The American Dietetic Association. Courses included have been approved as meeting the academic requirements of the American Dietetic Association. There is a \$30 fee for a statement of verification of completion of the approved program.

Cr. Degree Requirements

- 9.5** **Interpersonal and public communication skills**
Engl 104, 105; Lib 160; Sp Cm 212
- 33-34** **Mathematical, physical, and life sciences**
3 cr college-level math; Stat 101 or 104; Chem 163, 163L, 231, 231L; BBMB 301, 311; Biol 201, 202; Micro 201; Zool 155, 156
- 17** **Humanities, ethics, and social science**
Econ 101; Env S 201; Psych 101; select 3 credits each for international perspective and ethics (see approved lists.); 3 cr. in humanities.
- 50.5** **Food science and human nutrition**
FS HN 110, 167, 203, 214, 261, 340, 360, 361, 362, 403, 411, 461, 463, 464, 466, 480; H R I 380, 380L, 391, 392
- 9-10** **Free electives**
- 120** **Total credits**

Typical Program for the First Year

- Cr. Fall**
- 5 General Chemistry— Chem 163, 163L
- 3 Principles of Biology— Biol 201
- 3 First-Year Composition— Engl 104
- 3 Intro to Psychology— Psych 101
- 0.5 Orientation— FS HN 101
- Cr. Spring**
- 3 Principles of Biology— Biol 202
- 3 First-Year Composition— Engl 105
- 3 Human Nutrition— FS HN 167
- 3 College Level Math
- .5 Library— Lib 160

Curriculum in Entomology

Cr. Degree Requirements

- 12.5** **Interpersonal and public communication skills**
Engl 104, 105, 314; Sp Cm 212; Lib 160; and communications-intensive requirement
- 3** **Mathematical and physical sciences**
Stat 104
- 14** **Life sciences**
Biol 201, 201L, 202, 202L, 312; Micro 302
- 15** **Humanities, ethics, and social science**
Econ 101; 3 cr. in humanities; from approved lists: 3 cr. in ethics; 3 cr. in international perspectives; 3 cr. in U.S. diversity; and environmental-intensive requirement; and problem solving-intensive requirement
- 19** **Entomology**
Ent 110, 201, 211, 370, 374, 376; Ent 490E or P M 491; Ent electives; for students entering entomology with one year or more of college-level biological sciences courses, Ent 201 and 211 are waived, and the group requirement reduced to 16 cr.

Students majoring in Entomology are required to choose one of the following options by the end of their sophomore year; Agricultural and Horticultural Insect Management, Community and Structural Insect Management, or Insect Biology.

Agricultural and Horticultural Insect Management Option

Cr. Degree Requirements

- 5** **Mathematics**
Math 140, 141
- 16** **Physical Sciences**
Chem 163, 163L, 164, 231, 231L; Phys 106
- 6** **Biological Sciences**
BBMB 301; Bot 320
- 12** **Agricultural Sciences**
Agron 114 or Hort 221; Agron 154 or 155, 317; PI HP 407
- 5** **Entomology**
Ent 283, 375
- 6** **Social Sciences**
Acct 215; Econ 135
- 14.5** **Free electives**

Community and Structural Insect Management Option

Cr. Degree Requirements

- 5** **Mathematics**
Math 140, 141
- 16** **Physical Sciences**
Chem 163, 163L, 164, 231, 231L; Phys 106
- 3** **Biological Sciences**
BBMB 301
- 15** **Agricultural Sciences**
Hort 221; Agron 154 or 155; PI HP 391, 416; For 475
- 3** **Entomology**
Ent 373
- 3** **Social Sciences**
Acct 215
- 19.5** **Free electives**

Insect Biology Option

Cr. Degree Requirements

- 4** **Mathematics**
Math 181



- 28 Physical Sciences
Chem 177, 177L, 178, 178L, 211, 331, 331L, 332; Phys 111, 112
- 17-18 Biological Sciences
Biol 301, 301L, 302, 302L, 303; Bot 320 or Zool 355; Zool 405
- 14.5-15.5 Free electives

Typical Program for the First Year

Cr.	Fall
3	First-Year Composition—Engl 104
3	Principles of Biology—Biol 201
1	Laboratory in Principles of Biology—Biol 201L
4	General Chemistry—Chem 163 or 177
1	Laboratory in General Chemistry—Chem 163L or 177L
4	Fundamentals of Algebra for Science and Higher Mathematics—Math 140 or Calculus and Differential Equations—Math 181
R	Orientation in Entomology—Ent 110
Cr.	Spring
3	First-Year Composition—Engl 105
3	General Chemistry—Chem 164, or 178, 178L
4	Principles of Biology—Biol 202, 202L
1	Introduction to Insects—Ent 201
2	Insects and Society—Ent 211
0.5	Library Instruction—Lib 160

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the entomology curriculum.

Curriculum in Environmental Science

Cr.	Degree Requirements
9.5	Communication Engl 104, 105; Lib 160; speech elective (3 cr.); communication-intensive requirement
11	Mathematical sciences Math 165 and 166 or 181 and 182; Stat 104; proficiency in computer use
20	Physical sciences Chem 177, 177L, 178, plus 4 credits from approved list.; Phys 111, 112
8	Biological sciences Biol 201, 201L and 202 or Micro 201
15	Humanities, ethics, and social science 3 cr. ethics, 3 cr. U.S. diversity, 3 cr. of international perspectives, 3 cr. of humanities, and 3 cr. of social sciences. All courses must be approved.

- 30 Environmental science
EnSci 101, 295, 330, 401, 402, 404, 404L, 495 and 15 approved elective credits at the 300-400 level; problem-solving intensive requirement
- 29.5 Free electives
- 128 Total credits

Typical Program for the First Year

Cr.	Fall
3	Princ. Biology—Biol 201
1	Princ. Biology Lab Biol —201L
4	Gen Chem —Chem 177
1	Gen Chem Lab —Chem 177L
4	Calc. Life Sci. —Math 181
3	First Year Comp — Engl 104
R	Orientation — EnSci 101
16	Total
Cr.	Spring
3	Princ. Biology II—Biol 202
4	Gen Chem II — Chem 178
4	Calc. Life Sci II. —Math 182
3	First Year Comp. —Engl 105
.5	Library Instruction —Lib 160
14.5	Total

Curriculum in Food Science

Administered by the Department of Food Science and Human Nutrition.

Food Science and Technology Option

Cr.	Degree Requirements
9.5	Interpersonal and public communication skills Engl 104, 105; Lib 160; CmStd 101 or 102 or Sp Cm 212
47-48	Mathematical, physical, and life sciences Math 165, 166 or 181, 182; Stat 101 or 104; Chem 177, 177L, 178; Chem 331, 331L, 332; Phys 111, 112; BBMB 301; Biol 201, 202; Micro 201L, 302
17	Humanities, ethics, and social science Env S 201; select 3 credits each for humanities, U.S. diversity, international perspective and ethics, plus additional credits to total 17 (see approved lists).
34.5	Food science and human nutrition FS HN 110;167; 203, 311, 351, 403, 410, 412, 420, 421, 471, 472, 480, + additional FS HN courses at the 200 level or above (except FS HN 228) or An S 270, 360, 470 to total 34.5 credits. Credit allowed for FS HN 101 only if taken prior to enrollment in or during the first year in the FS HN department.
11-12	Free electives
120	Total credits

Typical Program for the First Year

Cr.	Fall
5	General Chemistry—Chem 177, 177L
3	Principles of Biology —Biol 201
3	First-Year Composition —Engl 104
4	Calculus I —Math 165 or 181
.5	Orientation —FS HN 110
Cr.	Spring
3	General Chemistry—Chem 178
3	Principles of Biology —Biol 202
3	First-Year Composition —Engl 105
4	Calculus II —Math 166 or 182
1	FCS & Agric Systems —FS HN 203
.5	Library —Lib 160

Food Science and Industry Option

Cr.	Degree Requirements
12.5	Interpersonal and public communication skills Engl 104, 105; Lib 160; Sp Cm 212; + 3 credits from Engl 302, 305, 309, 314, 405, 415, 416, HD FS 370, JI MC 205, Advrt 230, Sp Cm 312
31-33	Mathematical, physical, and life sciences Math 151 or above; Stat 101 or 104; Chem 163, 163L, 231, 231L; Phys 106; BBMB 301; Biol 201, 202; Micro 201 or 302, 201L
17	Humanities, ethics, and social science Env S 201; or Psych 230; select 3 credits each for U.S. diversity, international perspective and ethics (see approved lists). Additional 6 credits in humanities and/or social science.
37.5	Food science and human nutrition FS HN 110, 167, 202, 203, 311, 351, 403, 405, 410, 412, 420, 421, 471, 472, 480.
8-11	Emphasis area (See departmental approved course list)
9-14	Free electives
120	Total credits

Typical Program for the First Year

Cr.	Fall
5	General Chemistry—Chem 163, 163L
3	Principles of Biology —Biol 201
3	First-Year Composition —Engl 104
3	Humanities or Social Science elective
.5	Orientation —FS HN 110
Cr.	Spring
3	Food Quality Evaluation—FS HN 202
3	Principles of Biology —Biol 202
3	First-Year Composition —Engl 105
3	Math 151
.5	Library Lib —160
3	Elective

Consumer Food Science Option

Cr. Degree Requirements

- 18.5 Interpersonal and public communication skills
Engl 104, 105, 302 or 314;
JI MC 205; Advrt, 230; Lib 160; Sp
Cm 212
- 34-36 Mathematical, physical, and life sciences
3 cr. college-level math; Stat 101
or 104; Chem 163, 163L, 231,
231L; Phys 106; BBMB 301; Biol
201, 202; Micro 201, 302, 201L;
Zool 155
- 17 Humanities, ethics, and social science
Econ 101; Mkt 340, 447;
Env S 201; select 3 credits each
for U.S. diversity, international
perspective and ethics (see
approved lists), plus 3 additional
credits in humanities.
- 36.5 Food science and human nutri-
tion
FS HN 110, 167, 203, 214, 261,
311, 360, 403, 406, 411, 412, 420,
471, 480.
- 12-14.5 Free electives
- 120 Total credits

Typical Program for the First Year

Cr. Fall

- 5 General Chemistry—Chem 163,
163L
- 3 Principles of Biology —Biol 201
- 3 First-Year Composition —Engl 104
- .5 Orientation —FS HN 110

Cr. Spring

- 3 Principles of Biology —Biol 202
- 3 First-Year Composition —Engl 105
- 3 Math for Business and Social
Sciences —Math 150 or alternate
- 3 Introduction to Human Nutrition—
FS HN 167
- .5 Library —Lib 160
- 3-4 Stat 101 or 104

Curriculum in Food Science and Technology- B.S./M.S.

Administered by the Department of Food Science and Human Nutrition.

Undergraduate Program:

Cr. Degree Requirements

- 9.5 Interpersonal and public communications skills
Engl 104, 105, Lib 160, CmStd
101 or 102 or Sp Cm 212
- 50-51 Mathematical, physical, and life sciences
Math 165, 166 or 181, 182, Stat
101 or 104; Chem 177, 177L, 178,
331, 331L, 332, Phys 111, 112;
BBMB 404, 405, Biol 201, 202,
Micro 201L, 302

- 17 Humanities, ethics, and social science
Env S 201; select 3 credits each
for humanities, U.S. diversity,
international perspective and
ethics (see approved lists) plus
additional credits to total 17.
- 34.5 Food science and human nutri-
tion
FS HN 110, 167, 203, 311, 351,
403, 410, 412, 420, 421, 471, 472,
480; additional credits in FS HN
courses at 200-level or above
(except 228) or An S 270, 360,
470 to total 34.5 cr. Credit
allowed for FS HN 101 only if
taken prior to enrollment in or dur-
ing the first year in the FS HN
department
- 8-9 Electives
- 120 Total credits

Typical Program for the First Year

Cr. Fall

- 5 General Chemistry—Chem 177,
177L
- 3 Principles of Biology —Biol 201
- 3 First-Year Composition —Engl 104
- 4 Calculus I —Math 165 or 181
- .5 Orientation —FS HN 110

Cr. Spring

- 3 General Chemistry—Chem 178
- 3 Principles of Biology —Biol 202
- 3 First-Year Composition —Engl 105
- 4 Calculus II —Math 166, 182
- 1 FCS & Agric. Systems —FS HN
203
- 0.5 Library —Lib 160

Graduate Program:

Cr. Degree Requirements

- 30 Graduate-level coursework includ-
ing research

Curriculum in Forestry

Cr. Degree Requirements

- 12.5 Interpersonal and public communication skills
Engl 104, 105, 314; Lib 160; Sp
Cm 212
- 25 Mathematical, physical, and life sciences
Math 140, 150, 151; Stat 101;
Chem 163, 163L; Biol 201, 201L;
Agron 154
- 15 Humanities, ethics, and social science
3 cr. in humanities; Econ 101; 3
cr. in ethics from approved list;
and 3 cr. in U.S. diversity and 3 cr.
in international perspectives
- 35 Forestry courses
For 104, 110, 120, 201, 202, 203,
204, 205, 206, 280, 281, 302, 451,
452, 454

Students majoring in forestry are required to choose one of the following options at the end of their sophomore year: forest ecosystem

management or wood products or urban and community forestry.

Options

Cr.

- 19 Wood products
For 453, 481, 483, 485, 486, 487
- 27 Forest ecosystem management
Bot 356; For 301, 342, 345, 453,
455; PI P 416; 6 credits from
approved multiple use courses
(see department for list)
- 32 Urban and Community Forestry
Bot 356; For 475, 476; Hort 344;
Mgmt 370; PI P 416; Soc 310,
464; C R P 253; 3 credits from
approved multiple use courses
(see department for list)

8.5-21.5 Free electives

128 Total credits

Typical Program for the First Year

Cr. Fall

- 3 First-Year Composition I—Engl
104
- R Orientation in Forestry—For 110
- 3 Fundamentals of Algebra—Math
140
- 3 Principles of Biology I—Biol 201
- 1 Principles of Biology Laboratory
I—Biol 201L
- 3 Introduction to Renewable
Resources—For 120
- 3 Principles of Microeconomics—
Econ 101

16

Cr. Spring

- 3 Foundations of Soil Science—
Agron 154
- 0.5 Library —Lib 160
- 3 First-Year Composition II—Engl
105
- 4 General Chemistry I —Chem 163
- 1 General Chemistry Lab I —Chem
163L
- 3 Wood Anatomy and Properties—
For 280
- 1 Wood Identification—For 281

15.5

Curriculum in Genetics

Administered by the Department of Zoology and Genetics.

Cr. Degree Requirements

- 12.5 Communications
Engl 104, 105; an advanced
English writing course (Engl 302-
316); oral communication (AgEdS
311, Sp Cm 212; Lib 160
- 11 Math
Must include at least one course
from both calculus and statistics
chosen from Math 160, 165, 166,
181, 182; Stat 101 or 104, 401,
402, 403

- 3 **Computer Studies**
Three credits in computer science or computer applications chosen from an approved list. See department for list.
- 31 **Physical sciences**
Chem 177, 177L, 178, 178L (or 211), 331, 331L, 332, 332L; BBMB 404 or 420; Chem 211 or 321 or BBMB 405 or 411; Physics 111, 112 or 221, 222
- 23 **Biological sciences**
Biol 201, 201L, 302, 202L, 301, 301L, 302, 302L; Micro 302; Biol 303
- 15 **Humanities, ethics, and social sciences**
15 credits including at least 3 credits each in the humanities, social sciences, ethics, international perspectives and U.S. diversity chosen from an approved list. The environment-intensive and problem solving-intensive college requirements can be satisfied by selection of appropriate courses. See department for lists.
- 9.5 **Genetics**
Gen 110, 410, 411, 460 or 462, 491
- 9 **Support electives**
Choose 9 credits from approved list. See department for list. Biol (A Ecl) 312 must be included in the program
- Electives**
Additional electives sufficient to equal the 128 credits required for graduation.
- 128 **Total credits**

Typical Program for the First Year

- Cr. Fall**
- 5 General Chemistry—Chem 177, 177L
- 3 First-Year Composition—Engl 104
- 4 Calculus—Math 160 or 165 or 181
- 4 Principles of Biology—Biol 201, 201L
- 0.5 Orientation and Career Opportunities—Gen 110
- 0.5 Library Instruction—Lib 160
- Cr. Spring**
- 4 General Chemistry—Chem 178, 178L
- 3 First-Year Composition—Engl 105
- 4 Calculus—Math 161 or 166 or 182
- 4 Principles of Biology—Biol 202, 202L

Curriculum in Horticulture

Students majoring in horticulture will select an option in which to specialize prior to reaching junior standing and will fulfill the requirements described below under Specialization Options.

A minor is available. The requirements appear under Horticulture, Courses and Programs.

- Cr. Degree Requirements**
- 12.5 **Interpersonal and Public Communication Skills**
Engl 104, 105, 302 or 314; Lib 160; Sp Cm 212; and a communications-intensive requirement (see department for procedure)
- 6-9 **Mathematical sciences**
Math 104 or 105 or 140 or 150 or 165 or 181; and Stat 101 or 104 or 227 or 401
- 13 **Physical sciences**
Chem 163, 163L; or 177, 177L; and 231, 231L, or 331, 331L; and one course from the following group: Chem 164, 164L; 178, 178L; or Phys 106 or 111. A student must take either (1) Chem 163/163L and Chem 231/231L series or (2) Chem 177/177L and 178/178L series and Chem 331/331L.
- 19-20 **Biological sciences**
Biol 201, 202; select 13-14 credits from the following group: Bot 320, 306, 484; Biol 312; Agron 230; Agron 260; Agron 317; Agron 354; Ent 370 or 376; Ent 375; Bot 404; PI P 407; For 416; PI HP 391; Biol 201L; Biol 202L; Gen 320 or Biol 301, 301L; Biol 302, 302L
- 15 **Humanities, ethics, and social sciences**
3 credit course from each of the following areas: humanities, ethics, social science, U. S. diversity, and international perspectives; see department for procedure in meeting problem-solving, environmental-intensive, and communication-intensive requirements.
- 3 **Soil science**
Agron 154 or 155
- 30 **Horticultural sciences**
Hort 110, 221, 420; select a minimum of 24 credits from the following group: Hort 233, 241, 243, 253, 283, 321, 322, 332, 338, 342, 344, 351, 351L, 421, 422, 423, 424, 425, 434, 435, 442, 444, 451, 452, 461, 471, 475, 490, 391. Transfer students may transfer up to 10 credits of 200- and 300- courses in the horticultural sciences area.
- Specialized Options**
(a minor in an approved area of study may be substituted for the specialized option with permission of student's advisor)

- 12 **Environmental horticulture option:**
Hort 424 must be among the courses that fulfill the horticultural sciences requirement. Biol 312 and 9 or more credits from the following group: AST 324, 425, Agron 260, Bot 304, 364, Ent 375, Env S 293, 330, 382, 491
- 12 **Greenhouse production and management option:**
Hort 233, 322, 332, 422, 434, and 435 must be among the courses that fulfill the Horticultural Sciences requirement. Acct 284; and 9 or more credits from the following group: Econ 101, 102; Acct 215, 285; AST 358; Com S 103, 107 or AST 181; Mkt 340, 341; Ent 375; Mkt 442, 446, 447
- 12 **Fruit and vegetable production and management option:**
Hort 422, 461, and 471 must be among the courses that fulfill the Horticultural Sciences requirement. Acct 284; and 9 or more credits from the following group: FS HN 372, 202, 471, 472, 403, 405; Econ 101, 102, 330; Acct 215, 285; AST 358, 181 or Com S 103 or 107; Mgmt 370; Mkt 340, 341, 442, 446, 447
- 20 **Horticultural communications and public education:**
Students in this option must take Engl 314 under Interpersonal and Public Communications Skills and a minimum of 20 credits from the following group: Engl 220, Engl 303, Engl 305, ComSt 102, ComSt 214, ComSt 317, Sp Cm 171, 312, 313, AgEds 310, AgEds 311, AgEds 410, JI MC 320
- 12 **Nursery crops production and management option:**
Hort 241, 243, 322, 342, 421, and 442 must be among the courses that fulfill the Horticultural Sciences requirement. Acct 284; and 9 or more credits from the following group: Acct 215, 285; AST 358; Agron 206; Com S 103 or 107 or AST 181; Econ 101, 102, 330; Mgmt 370; Mkt 340, 341, 442, 446, 447
- 12 **Science option:**
Those who choose the Science Option must take Bot 320 for the biological sciences requirement. Math 165 or 181 for the mathematical sciences requirement; Chem 177, 177L, 178, 178L, 331, 331L, 332, 332L, Phys 111 and 112 for the physical sciences requirement. BBMB 301 or 404, Math 166 or 182; and 5 or more credits from the following group: BBMB 311, 404, 405, 411; Bot 303; Chem 210 or 211, 316, 321, 322, 322L; Com S 107 or 205; Gen 410, 411; Biol 301, 301L, 302, 302L

- 12 Turfgrass management option: Hort 351, 351L, 451, and 452 should be among the courses that fulfill the Horticultural Sciences requirement. Acct 284 and 9 or more credits from the following group: Acct 285; AST 324, 326, 358; Agron 206,260, 356, 459; Com S 103 or 107 or AST 181; HRI 287, 288, 289; Mgmt 370; PI HP 206, 391; Ent 375

14-18 Electives

128.5 Total credits

An official minor will be accepted in place of a specialized option with the permission of the student's adviser.

Typical Program for the First Year

- | | |
|------------|---|
| Cr. | Fall |
| 3 | Humanities or Free Elective |
| 5 | General Chemistry—Chem 163, 163L or 177, 177L |
| 3 | First-Year Composition—Engl 104 or 105 |
| R | Orientation in Horticulture—Hort 110 |
| 0.5 | Library Instruction—Lib 160 |
| 3 | Fundamentals of Algebra for Science and Higher Mathematics—Math 140 |
| Cr. | Spring |
| 3 | General Biology—Biol 201 |
| 4 | General Chemistry—Chem 164, 164L, 177, 177L (or Phys 106 or 111) |
| 3 | Humanities or social science from an approved list |
| 3 | First year composition—Engl 105 or Soils for Horticultural Scientists—Agron 155 |
| 3 | Elective |

Curriculum in International Agriculture

Administered by an Interdepartmental Committee. International agriculture can be taken only as a secondary major in conjunction with a primary major in the College of Agriculture. A minor is available to interested students regardless of their major.

Cr. Degree Requirements

(Additional prerequisites may be required for some courses.)

- 12.5 **Interpersonal and public communication skills**
Engl 104, 105; Sp Cm 212 or AgEdS 311; Lib 160; electives (3 cr.) select from Engl 302 or 314, or JI MC 205; and communications-intensive requirement (See primary major department for procedure to meet core requirements.)

- 19 **Mathematics, physical, and life sciences**
Math 150, Chem 163, 163L, or Chem 177, 177L, math or physical science electives select from BBMB, Chem, Com S, Math, Phys, or Stat(5 cr.); biological sciences electives select from Biol, Bot, Gen, Micro, PI HP or Zool (6 cr.) and demonstration of computer proficiency (See primary major department.)

- 15 **Humanities, ethics, and social sciences**
Soc 130 or 134, or Econ 101; Anthr 201; 3 cr. in ethics; 3 cr. in U.S. diversity or 3 cr. in International perspectives; environmental-intensive requirement; and problem solving-intensive requirement (See primary major department for intensive requirements.)

- 15 **International Agriculture**
Internship in International Agriculture or Study Abroad Program or Foreign Language (6cr.). Select courses with international agriculture focus in any major in the College of Agriculture (9 cr.)

- 66.5 **Primary major requirements and free electives**

128 Total credits

Program for the First Year

Because international agriculture is a secondary major, the courses taken by the student during the first year will vary, depending on the primary major (see typical program for the primary major).

Curriculum in Microbiology

microbes.micro.iastate.edu/mipmhome.html

Administered by the Department of Microbiology.

Cr. Degree Requirements

- 9.5 **Interpersonal and public communication skills**
Engl 104, 105; Lib 160; Sp Cm 212
- 10-12 **Mathematical sciences**
Stat 101 or 104 required; 2 semesters of math with at least one semester of calculus
- 24-30 **Physical sciences**
Chemistry: minimum of 8 credits in general chemistry with at least one laboratory course; minimum of 4 credits in organic chemistry (Chem 331, 331L, 332, 332L recommended)
Biochemistry: minimum of 4 credits. BBMB 404, 405 (recommended) or Biol 302 and 302L or BBMB 301 and 311, or 420
Physics: 8 credits from Phys 111, 112, 221, 222.

- 11 **Biological sciences**
Biol 201, 201L, 202, 202L, and 301.

- 15 **Humanities, ethics, and social sciences**
Minimum of 3 credits each in courses in humanities and social sciences. Also, 3 credits each in ethics, international perspectives, and U.S. diversity courses selected from approved lists.

- 35 **Microbiology**
Required: Micro 110, 302, 310, and 320; 11 credits of laboratory modules: Micro 341, 342, 343, 344, 345, 441, 442, 443, 444, 445, and 446; a minimum of 3 cr. each in infectious disease courses, microbial physiology/genetics courses, and microbial ecology/environmental courses.

15.5-23.5 Electives

128 Total credits

Typical Program for the First Year

- | | |
|------------|---|
| Cr. | Fall |
| 4 | General Chemistry—Chem 163 or 177 |
| 1 | Laboratory in General Chemistry—Chem 163L or 177L |
| 3 | First-Year Composition—Engl 104 |
| 3 | Principles of Biology—Biol 201 |
| 1 | Laboratory in General Biology—Biol 201L |
| 3 | Humanities, ethics, or social science |
| 0.5 | Library 160 |
| R | Orientation in Microbiology—Micro 110 |
| Cr. | Spring |
| 3 | General Chemistry—Chem 164 or 178 |
| 3 | First-Year Composition—Engl 105 |
| 3 | Principles of Biology—Biol 202 |
| 1 | Laboratory in General Biology—Biol 202L |
| 3 | Biology of Microorganisms —Micro 302 |
| 3 | Mathematics —Math 142 |

Preveterinary Studies

Preparation for admission to veterinary medicine may be accomplished through the microbiology curriculum.

Curriculum in Nutritional Science

Administered by the Department of Food Science and Human Nutrition.

Cr. Degree Requirements

- 19.5 **Interpersonal and public communication skills**
Engl 104, 105; Lib 160; Sp Cm 212
- 53-54 **Mathematical, physical, and life sciences**
4 cr. calculus (2 semesters preferred); Stat 101 or 104; Chem 177, 177L, 178; 331, 331L, 332, 332L; Phys 111, 112; Biol 201, 201L, 202, 202L, 301, 302; Micro 201L, 302; Zool 355
- 17 **Humanities, ethics, and social science**
Env S 201; select 3 credits each for U.S. diversity, international perspective and ethics (see approved lists). Select 3 additional credits each in humanities or social science category.
- 27.5-31.5 **Food science and human nutrition**
FS HN 110, 203, 214 or 311, 261, 360, 362, 480, + 14-16 cr. from the following: FS HN 361, 403, 419 or 519, 461, 463, 464, 466, 490C, 499, 560, 562, 565, 575
- 8-13 **Free electives**
- 120 **Total credits**

Typical Program for the First Year

- Cr. Fall**
- 5 General Chemistry—Chem 177, 177L
- 4 Principles of Biology —Biol 201, 201L
- 3 First-Year Composition —Engl 104
- 4 Calculus
- 0.5 Orientation —FS HN 110
- Cr. Spring**
- 4 Principles of Biology —Biol 202, 202L
- 3 First-Year Composition —Engl 105
- 3-4 Calculus or Elective
- 3 General Chemistry —Chem 178
- 0.5 Library —Lib 160
- 1 FCS & Agric Systems —FS HN 203

Curriculum in Nutrition-B.S./M.S.

Administered by the Department of Food Science and Human Nutrition.

Undergraduate Program:

- Cr. Degree Requirements**
- 9.5 **Interpersonal and public communication skills**
Engl 104, 105, Lib 160, Sp Cm 212
- 51-58 **Mathematical, physical, and life sciences**
4 credits in calculus (2 semesters preferred), Stat 104 or 101; Chem 177, 177L, 178, 331, 331L, 332, 332L, Phys 111, 112; BBMB 404, 405 or 420; Biol 201, 201L, 202, 202L; Micro 201L, 302; Zool 355
- 17 **Humanities, ethics, and social science**
Env S 201; select 3 credits each for U.S. diversity, international perspective and ethics (see approved lists). Select 3 additional credits each in humanities and social science
- 27.5-31.5 **Food science and human nutrition**
FS HN 110, 203, 214 or 311; 261, 360, 480; select 14-16 credits from: FS HN 361, 403, 419 or 519, 461, 463, 464, 466, 490C, 499, 560, 562, 565, 575
- 8-15 **Electives**
- 120 **Total credits**

Typical Program for the First Year

- Cr. Fall**
- 5 General Chemistry—Chem 177, 177L
- 4 Principles of Biology —Biol 201, 201L
- 3 First-Year Composition —Engl 104
- 4 Calculus
- 0.5 Orientation —FS HN 110
- Cr. Spring**
- 4 Principles of Biology —Biol 202, 202L
- 3 First-Year Composition —Engl 105
- 3-4 Calculus or Elective
- 3 General Chemistry—Chem 178
- 0.5 Library —Lib 160
- 1 FCS & Agric Systems —FS HN 203

Graduate Program:

- Cr. Degree Requirements**
- 30 Graduate-level coursework including research

See department for graduate requirements.

Curriculum in Pest Management

Administered by the departments of Agronomy, Animal Ecology, Entomology, Forestry, Horticulture, and Plant Pathology. Must be taken as a secondary major in conjunction with a primary major. Students with primary majors in other than the sponsoring departments also are encouraged to enroll in the pest management program. Additionally, a minor in pest management is available; the requirements appear under Pest Management, Courses and Programs.

Cr. Degree Requirements

- 12.5 **Interpersonal and public communication skills**
Engl 104, 105 and a minimum of 3 cr. in speech fundamentals with grades of C or better; Lib 160; electives and a communication-intensive requirement
- 6 **Mathematical sciences**
Stat 104; 3 cr. in mathematics, statistics or computer science; students must demonstrate computer proficiency according to procedures established by their primary major
- 9 **Physical sciences**
Chem 163, 163L, 231, 231L
- 16-17 **Biological sciences**
Biol 201, 201L, 202, 202L; Gen 320; any 2 courses of the following: BMBB 301; Biol 303, 312; Bot 320, 484; Ent 370; Micro 201, 302
- 15 **Humanities, ethics, and social science**
3 cr. in economics or marketing; 3 cr. in humanities; 3 cr. in international perspectives; 3 cr. in U.S. diversity; 3 cr. in ethics; and environmental-intensive requirement; and problem solving-intensive requirement
- 9-10 **Agricultural sciences**
Agron 114 or For 301 or Hort 221; Agron 154 or 155; Agron 206
- 18-22 **Pest management**
P M 283, 317, 376, 491, 499; P M 407 or P M 416; A Ecl 120 or 130; electives (any one course from approved list) An approved list of elective courses may be obtained from the pest management adviser in participating departments.
- 36.5-42.5 **Primary major requirements and free electives**
- 128 **Total credits**

Typical Program for the First Year

Because pest management is a secondary major, the courses taken by the student during the first year will vary, depending on the primary major (see typical program for the primary major). It is recommended, however, that the following courses be included early in the program:

Cr.	
2-3	Principles of Crop Production—Agron 114 or Forest Ecology—For 301 or Principles of Horticulture—Hort 221 or Wildlife and Agriculture —A Ecl 130
6	Principles of Biology—Biol 201, 202

Curriculum in Plant Health and Protection

Administered by the Departments of Agronomy, Entomology, Forestry, Horticulture, and Plant Pathology. A minor in plant health and protection is available; the requirements appear under Plant Health and Protection, Courses and Programs.

Cr.	Degree Requirements
12.5	Interpersonal and public communication skills Engl 104, 105, 302 or 314; Lib 160; Sp Cm 212 or AgEdS 311
6-10	Mathematical sciences Math 140; Stat 104; Com S 103 or AST 181 or demonstration of computer proficiency
12-13	Physical sciences Chem 163, 163L, 231, 231L; Phys 106 or Chem 164
19-20	Biological sciences Biol 201, 201L, 202, 202L; Biol 301 or Agron 320; Bot 320 or Agron 230 or Hort 321; 6 cr. from the following: Micro 201 or 302, 201L; BBMB 301; Biol 302, 303, 312; Bot 404, 406; Env S 201
15	Humanities, ethics, and social science Econ 101; 3 credits in humanities; from an approved lists: 3 cr. in ethics, 3 cr. international perspectives; 3 credits in U.S. diversity.
17	Agricultural sciences Agron 114 or Hort 221; Agron 154 or 155; Agron 206; 8 cr. from the following: Agron 260, 338, 356, 421, 450, 485; Ent 283, 375; For 475; Hort 322, 332, 421, 424, 425; PI P 452, 477
20-22	Plant health and protection PI HP 110, 206, 391, 392, 498; Agron 317; Hort 420 or Agron 354/354L; Ent 376; PI P 407 or 416; and environmental-intensive requirement, communication-intensive requirement, problem solving-intensive requirement
18.5-26.5	Free electives
128	Total credits

Typical Program for the First Year

Cr.	Fall
3	First-Year Composition—Engl 104
3	College Algebra—Math 140
4	Principles of Biology—Biol 201, 201L
4	General Chemistry—Chem 163
1	Laboratory in General Chemistry—Chem 163L
0.5	Library Instruction—Lib 160
R	Orientation in Plant Health and Protection—PI HP 110
Cr.	Spring
3	First-Year Composition—Engl 105
4	Principles of Biology—Biol 202, 202L
3	Humanities requirement
3	Fundamentals of Agronomy or Principles of Horticulture—Agron 114 or Hort 221
3	Plant Health Biology—PI HP 206

Curriculum in Professional Agriculture

An interdepartmental curriculum offered by the College of Agriculture designed for students who have completed foundation program courses and desire to complete their degrees off campus. The curriculum's administrative home is the Department of Agricultural Education and Studies. Coursework is usually delivered via video-tape, Iowa Communications Network, World Wide Web, on-campus workshops and labs, or at locations away from the Ames campus; see *Off-Campus, Credit Courses and Programs*.

Foundation Program

Cr.	Requirements
12.5	Interpersonal and public communication skills Engl 104, 105; Lib 160; speech elective (3 cr.); written communications electives (3 cr.); communication-intensive requirement
17	Mathematical, physical, and life sciences Chem 163, 163L; Math 140; Stat 104; life sciences elective (6 cr.); demonstration of computer proficiency; environmental-intensive requirement
15	Humanities, ethics, and social sciences Econ 101; from approved lists: 3 cr. in ethics, 3 cr. in international perspectives, 3 cr. in U.S. diversity; elective (3 cr.); problem-solving intensive requirement
19.5	Electives Suggested electives include introductory courses in crops, soils, animal science, and accounting
64	Total foundation program cr.

Agricultural Science Program

Cr.	Degree Requirements
45	Agricultural social sciences and economics Select 3 courses from: AgEdS 311, 315; Econ 135, 330, 452; Soc 325, 415
	Animal sciences and Animal ecology Select 3 courses from: A Ecl 120, 130, 442; An S 270, 319; AST 474
	Plant and soil sciences Select 3 courses from: AST 324, 420; Agron 206, 317, 354, 450; Ent 376; Hort 351, 471; PI P 407
	Restricted Agriculture Electives Select one course from AST at the 300 level or higher On-campus agricultural science workshops Equivalent of 2 credits Agricultural science coursework (300 level or higher) May include courses listed above not used for group requirement; excludes judging, travel courses, and independent study
19	Electives
64	Total agricultural science program credits
128	Total credits

Curriculum in Public Service and Administration in Agriculture

Administered by the Department of Sociology.

Cr.	Degree Requirements
12.5	Interpersonal and public communication skills Engl 104, 105; JI MC 205; Sp Cm 212; Lib 160; communication-intensive requirement
18	Mathematical, physical and life sciences Math 150; Stat 101; electives in physical sciences (5 cr.); Biol 109; electives in biological sciences (3 cr.) (To fulfill the College's environmental intensive requirement, students are encouraged to choose Environmental Science 120 or 123 as the elective in the biological sciences; demonstration of computer proficiency) (see Sociology Department for requirements).

- 12 **Humanities, ethics, and social sciences**
Humanities elective (3 cr.); from approved lists: 3 cr. in ethics; 3 cr. in U.S. diversity; 3 credits in international perspectives. The 3-credit College of Agriculture requirement in the social sciences is included as part of the Public Service and Administration Core as are the environmental-intensive requirement and problem solving-intensive requirement.
- 46 **Public service and administration core**
Economics: 101, 102, 344, 336, 451
Political science: 215, 310, 371, 475, and 484
Sociology: 110, 130, 325, 415, 420 or 380, and 464
- 9 **Agricultural sciences**
- 15 **Required area of concentration**
- 15.5 **Free electives**
- 128 **Total credits**

Typical Program for the First Year

- | | |
|------------|---|
| Cr. | Fall |
| 3 | First-Year Composition—Engl 104 |
| 3 | Introductory Biology—Biol 109 |
| 3 | Mathematics for Business and Social Sciences I—Math 150 |
| 3 | Rural Institutions and Organizations—Soc 130 |
| 3 | Principles of Microeconomics—Econ 101 |
| R | Orientation to Public Service and Administration in Agriculture—Soc 110 |
| Cr. | Spring |
| 3 | First-Year Composition—Engl 105 |
| 3 | Principles of Macroeconomics—Econ 102 |
| 3 | American Government: Institutions and Policies—Pol S 215 |
| 3 | Fundamentals of Speech Communication—Sp Cm 212 |
| 3 | Agricultural Science |
| 0.5 | Library Instruction—Lib 160 |

Curriculum in Seed Science

Administered by the Departments of Agricultural and Biosystems Engineering, Agronomy, Horticulture, and Plant Pathology. Must be taken as a secondary major in conjunction with a primary major. The seed science program is designed for students with career interests in one or more aspects of the seed industry. Areas of study include: seed production, conditioning, pathology, physiology, quality control, and marketing, as well as seed plant designs.

- | | |
|------------|---|
| Cr. | Degree Requirements |
| 12.5 | Interpersonal and public communication skills
Engl 104, 105; Sp Cm 212 or |

AgEdS 311; Lib 160; Engl 302 or 309 or 314 or Sp Cm 312; and a communications-intensive requirement (see department of primary major for procedures)

- | | |
|-------------|--|
| 38 | Mathematical, physical, and life sciences
Math 140 or 150; Stat 101 or 104; Chem 163, 163L; BBMB 221 or Chem 231, 231L; Phys 106 or 111, or Chem 164, 164L; Biol 201, 201L; Biol 202, 202L; Ent 376; Gen 320 or Biol 301; Agron 317; PI P 407; and demonstration of computer proficiency (see department of primary major for procedures) |
| 15 | Humanities, ethics, and social science
3 cr. each of humanities, social sciences, ethics (from an approved list), U.S. diversity (from an approved list), and international perspectives (from an approved list); environmental intensive requirement (see department of primary major for procedures); and problem-solving intensive requirement (see department of primary major for procedures) |
| 21 | Agricultural sciences
Agron 114 or Hort 221; Agron 154, 206, 354; Agron or Hort electives (6 cr.); AST electives (3 cr.) |
| 9 | Economics and business
Econ 101, 135; and one course from the following group: Acct 284; Econ 102, 330, 336; Mgmt 370; Mkt 340 |
| 10 | Seed science
Agron 338, 421, 491, 492 |
| 22.5 | Primary major requirements and free electives |
| 128 | Total credits |

Typical Program for the First Year

Because seed science is a secondary major, the courses taken by the student during the first year will vary, depending on the primary major (see typical program for the primary major).

Curriculum in Zoology

Administered by the Department of Zoology and Genetics.

- | | |
|------------|--|
| Cr. | Degree Requirements |
| 12.5 | Communications
Engl 104, 105; an advanced English writing course (Engl 302-316); oral communication (AgEdS 311, Sp Cm 212); Lib 160 |
| 11 | Math
Must include at least one course from both calculus and statistics chosen from Math 160, 165, 166, 181, 182; Stat 101 or 104, 401, 402, 403 |
| 3 | Computer studies
3 credits in computer science or |

computer applications chosen from an approved list. See department for list.

- | | |
|-------------|---|
| 24 | Physical sciences
Chem 177, 177L, 178, 178L (or 211), or 163, 163L, 164, 164L; 231, 232 or 331, 331L, 332; 332L, or BBMB 404 or 420; Phys 111, 112 or 221, 222 |
| 16 | Biological sciences
Biol 201, 201L; 202, 202L; 301, 301L, 302, 302L |
| 15 | Humanities, ethics, and social sciences
15 credits including at least 3 credits each in the humanities, social sciences, ethics, international perspectives and U.S. diversity chosen from an approved list. The environmental-intensive and problem solving-intensive college requirements can be satisfied by selection of appropriate courses. See department for lists. |
| 21.5 | Zoology
Zool 110, 355; 17 credits in zoology numbered 300 or above, 7 of which must be numbered 400 or above. Two of the elective courses must include a laboratory. |
| 6 | Agricultural sciences
Choose 6 credits from any lecture or lab course numbered 300 or above taught by the following departments: Animal Ecology, Animal Science, or Entomology. Biol (A Ecl) 312 must be included in the program. |
| | Electives
Additional electives sufficient to equal the 128 credits required for graduation. |
| 128 | Total credits |

Typical Program for the First Year

- | | |
|------------|--|
| Cr. | Fall |
| 0.5 | Opportunities in Zoology—Zool 110 |
| 3 | First-Year Composition—Engl 104 |
| 4 | General Chemistry—Chem 177 |
| 1 | Laboratory in General Chemistry—Chem 177L |
| 4 | Calculus—Math 160 or 165 or 181 |
| 3 | General Biology—Biol 201 |
| 1 | Laboratory in General Biology—Biol 201L |
| 0.5 | Library Instruction—Lib 160 |
| Cr. | Spring |
| 3 | First-Year Composition —Engl 105 |
| 3 | General Chemistry —Chem 178 |
| 1 | Laboratory in General Chemistry —Chem 178L |
| 4 | Calculus —Math 161 or 166 or 182 |
| 3 | General Biology —Biol 202 |
| 1 | Laboratory in General Biology —Biol 202L |

College of Business

Departments of the College

Accounting
Finance
Logistics, Operations and Management
Information Systems
Management
Marketing

Objectives of the Curricula in Business

The instructional objective of the College of Business is to provide a high quality professional education in business. Such an education should provide the student with: (1) an appreciation of the evolution of the profession and an awareness of the social, technological, political, legal and economic forces shaping its future; (2) an understanding of the major functional areas of business with the opportunity for specialization for a career in business; (3) an ability to recognize and appreciate ethical and social values; (4) an opportunity for advanced study.

A comprehensive education in business includes a broad foundation in the liberal arts, course in the major functional areas of business activity, proficiency in analytical methods, and the ability to identify problems and arrive at logical solutions. In addition, a professional education is designed to inspire students to assume business and community leadership.

The curricula in business are accredited by the International Association for Management Education (AACSB), the national business accrediting agency.

Organization of Curricula

The undergraduate curricula in business are divided into two phases: a general education (pre-business) program and a professional program. The pre-business requirements provide a broad foundation in the liberal arts. The professional program includes two parts: (1) the business core which provides a common body of knowledge in all the functional areas in business, and (2) a major curriculum. The seven major curricula offered for the degree bachelor of science (B.S.) are accounting, finance, management, management information systems, marketing, production/operations management, and transportation and logistics. The College also offers a secondary major in international business. An opportunity to take elective courses is also a part of the curricula.

Bachelor of Science

The bachelor of science (B.S.) degree offers a high quality professional education in business. It prepares students for professional careers in specialized functions of business and government. Candidates for this degree must satisfy the requirements established by the College of Business and also the requirements for individual majors specified by the departments of the

college. All candidates for the B.S. degree are required to complete one of the following majors: accounting, finance, management, management information systems, marketing, production/operations management or transportation and logistics.

Required High School Preparation

Students entering the pre-business curriculum must present evidence of the following high school preparation:

- a. Four (4) years of English/Language Arts, emphasizing writing, speaking, and reading as well as an understanding and appreciation of literature.
- b. Three (3) years of mathematics, including one year each of algebra, geometry, and advanced algebra.
- c. Three (3) years of science, including one year each of courses from two of the following fields: biology, chemistry, and physics;
- d. Two (2) years of social studies.

Admission Standards to Professional Programs

All new entering students are enrolled in a pre-business curriculum. To enter the professional program in the College of Business, students must complete a minimum of 30 credits including the foundation courses and Engl 104 and Engl 105. Any unmet high school requirements and Engl 101 courses must also be complete. See Curriculum in Business.

Achievement of an Iowa State University cumulative grade-point average of 2.5 or a grade-point average of 2.5 in the foundation courses guarantees admission to the professional program in the College of Business. Students that have not achieved guaranteed admission are considered on a case-by-case basis. Professional program admission is then determined by available seat space in the College of Business.

Eligibility to apply for the University Honors Program also qualifies a student for admission to the professional program. Students who meet this criterion must still apply for admission to the professional program.

If using the foundation courses for admission to the Professional Program, both transfer grades and Iowa State University grades are used to compute the grade point average. If courses are repeated, foundation grades from Iowa State University are used instead of

transfer foundation grades. Courses at the 300 and 400 levels in the College of Business are usually not available to pre-business students. To facilitate registration, students may be conditionally admitted during the semester in which they complete the admission requirements.

Admission requirements are subject to change. Applications and the current requirements for admission to the College of Business are available from the Andersen Undergraduate Services Center in the College of Business.

Academic Standards and Graduation Requirements

Policies for students enrolled in the College of Business may be obtained from the Andersen Undergraduate Services Center in the College of Business. Students are responsible for knowing and adhering to these College of Business policies as well as the university regulations found in this catalog. The following policies are in effect for students graduating from a professional curriculum in business with a B.S. degree under the 1999-2001 catalog: (1) A minimum of 124.5 semester credits are required. (2) At least 50 percent of the required business credits must be earned at Iowa State. All 300 level and higher business credits must be earned at a four-year college. (3) A minimum of 12 credits of the last 32 credits earned in residence must be applied to the business core and/or the major. (4) The major departments reserve the right to determine the appropriate section of the degree program to which transfer credits will be assigned. (5) Students must achieve English proficiency by earning a grade at C or better in two of the three required English courses. (6) A student must earn a grade of C or higher in a minimum of 30 credits applied to the business core and the major. (7) A student must earn at least 42 credits of 300 level and higher coursework from a four-year institution. (8) Business majors may not take business courses Pass-Not Pass (P/NP). (9) General education courses may not be taken P/NP. (10) No more than 9 elective credits may be taken P/NP.

Curriculum in Business

Leading to the degree bachelor of science with a major in accounting, finance, management, management information systems, marketing, production/operations management or transportation and logistics. The College also offers a secondary major in international business. Total credits required: 124.5

Pre-business Curriculum

Cr.	
18	Foundation Courses
3	Math 150 ^{1,2}
4	Com S 103
3	Econ 101
5	Stat 227 ²
3	Acct 284
9.5	Other required courses
3	Acct 215
R	BusAd 100
3	Math 151 ^{1,2}
3	Econ 102
0.5	Lib 160
45	General Education Requirements
12	Communications
9	Engl 104, 105, 302
3	Sp Cm 212
9	Humanities
3	Phil 230
3	History course(s)
3	Select from approved list ³
3	Natural science
3	Select from approved list ³
6	Behavioral science
6	Select from departments of Anthropology, Psychology, or Sociology ³
6	Global perspectives
6	Select from approved list ³

U.S. Diversity Course⁴

International Perspectives Course⁴

¹Students not adequately prepared in mathematics may have to take remedial courses in addition to courses listed above. Remedial mathematics courses may not be used to satisfy credit requirements for graduation in the business curricula.

²Substitutions can be made. See the Andersen Undergraduate Services Center in the College of Business.

³Approved list of courses is available from the Andersen Undergraduate Services Center in the College of Business.

⁴Courses for this requirement may also be used to fulfill other curriculum requirements or electives and therefore credits are not included in the sum needed.

Professional Program

Cr.	
24	Business Core
3	Acct 285
3	Fin 350
6	Mgmt 370, 478

3	MIS 330
3	Mkt 340
3	POM 320
3	TrLog 360
18-21	Business Major
	Select one:
21	Accounting
18	Acct 383, 385, 386, 387, 496, 497
3	Select from Acct 388, 486, 487, 499
21	Finance
6	Fin 352, 354
9	Select from Fin 351, 357, 358, 451, 452, 453, 454, 455, 457, 459, 499
6	Select from Acct 383, 385, 386, 387, 388, any 400 level Acct course, Econ 301, 344, 353, 355, 405
18	Management Option in Human Resources Management
6	Mgmt 371, 471
12	Select from department-approved list
18	Management Option in Entrepreneurship and Strategy
9	Mgmt 310, 377, either 413 or 415
9	Select from department-approved list
18	Management Option in General Business
15	Acct 383, Fin 352, Mgmt 371, 471, Mkt 447
3	Select from department-approved list
18	Management Information Systems
15	Com S 201, MIS 331, 432, 433, 435
3	Select from department-approved list
18	Marketing
9	Mkt 443, 444, 447
6	Select from Mkt 343, 410, 442, 446, 448, 449
3	Select from department-approved list
18	Production/Operations Management
9	POM 420, 422, 424
9	Select from department approved list
18	Transportation and Logistics
6	TrLog 460, 461
9	Select from TrLog 462, 463, 466, 468, 469
3	Select from department approved list
16-19	Elective Courses
6	Non-business electives. Select from departments outside Business. No Econ, Stat, or Bus Tech credits may be used.
10-13	Select courses to broaden or complement the requirements (see adviser).

Advising System

Students in the pre-business curriculum in the College of Business will be advised by a pre-business adviser. Following admission to the professional program students will be assigned a faculty adviser in their declared

major. The adviser assists students to develop an academic program, access pertinent university resources and meet their educational objectives.

The college offers an orientation program each summer for new entering students. All students and family members are encouraged to attend the orientation session. During orientation the adviser and the student prepare an appropriate schedule and the student registers for courses. Placement examinations may be required in mathematics and English to assist in placing students in the appropriate level of courses if this cannot be determined by ACT/SAT scores, high school preparation classes or transfer courses.

Honors

Pre-business students in the College of Business may apply for associate membership in the honors program; students may apply for full membership after admission to the professional program. Special advisers will assist honors students in developing an appropriate program of study.

Internships

Credit and non-credit internships in business may be approved for College of Business students in all majors including pre-business. Credit hours and requirements vary. Arrangements must be made in the College prior to the beginning of the internship.

Double Majors

Undergraduates with a primary major in the College of Business may complete another major in the College of Business. Those desiring a second major outside the college should refer to the catalog section of the appropriate college and department for the second major requirements.

Undergraduates with a primary major outside the College of Business wanting a second major in business must meet the admission requirements for the professional program, complete the business core courses, and the major specialization.

All students pursuing double majors or double degrees must have a minimum of fifteen credits for each major/degree that are not simultaneously used to meet any other department, college, or university requirements.

International Business Secondary Major

A student in the College of Business may earn a secondary major in International Business. The requirements for this major include 12 credits in international business courses, one year of the same university-level foreign language (minimum 6 credits) and an approved international experience (minimum 3 months). Students who pursue this secondary major will be required to complete the requirements for a primary major in Business. Fifteen of the 18 credits required for the International Business major must not simultaneously be used to meet any other department, college or university requirement.

Minor

The College of Business offers a structured minor in general business to students outside the college. Requirements for the minor are Acct 285, Fin 350, Mgmt 370, MIS 330, Mkt 340, POM 320, and TrLog 360. The minor must include at least 6 credits in courses numbered 300 or above taken at Iowa State University with a grade of C or higher. Students wishing to earn a minor in business must meet the admissions requirements of the College of Business professional program (see admission standards to professional programs).

Students with a primary major in the College of Business may qualify for a minor specialization in one of the college's departments by taking at least 15 credit hours in the minor specialization, nine hours of which may not be used to satisfy any other department, college, or university requirement. The minor must include at least 6 credits in courses numbered 300 or above taken at Iowa State University with a grade of C or higher.

The students with a major outside the College of Business are eligible for a general business minor only—not a specialization in a business department.

Entrepreneurial Studies Cross-Disciplinary Minor

The College of Business participates in a cross-disciplinary minor in Entrepreneurial Studies. This minor is only available to students outside the College of Business. Requirements for the minor include Mgmt 310, 313, and 9 credits from an approved list. The approved list is available in the Andersen Undergraduate Services Center in the College of Business. The minor must include at least 6 credits in courses numbered 300 or above taken at Iowa State University with a grade of C or higher.

Nondegree Seeking Students

Students who wish to take courses in the College of Business, but are not seeking an undergraduate degree, should apply to the college as nondegree seeking students. Nondegree seeking students are eligible to take up to 9 credits in 300-level and above business courses without meeting the college's admission requirements. Students who desire to take more than 9 credits, however, must meet the college's professional program admission requirements and have approval of a department chair. Nondegree seeking students must meet all course prerequisites.

Graduate Study

Two programs are offered at the graduate level: a master of business administration (M.B.A.) program and a master of science (M.S.) with a major in business administrative sciences. These programs are intended to meet two sets of educational objectives.

The M.B.A. is the professional management education program for those pursuing careers in business or industry. The purpose of this professional program is to provide a current professional business education by preparing students to understand the impact of technology on business organizations in a global environment. The M.B.A. program consists of a 48-credit curriculum leading to a nonthesis, noncreative component master of business administration. Students may pursue a specialization in accounting, agribusiness, finance, information systems, manufacturing and quality or marketing.

Fully-admitted M.B.A. degree candidates with previous business study as an undergraduate may qualify for advanced entry into the M.B.A. program. Advanced entry is designed to serve those students with a bachelor's degree in business as they may complete the M.B.A. degree program requirements in as few as 30 semester credit hours. Information about the advanced M.B.A. entry application process can be found in the College of Business Graduate Programs Office, 218 Carver Hall.

The M.S. program, consisting of 30 minimum credits, is oriented toward further business specialization at the master's level for students with undergraduate degrees or strong academic backgrounds in business. The program is intended to serve those students who desire specialized study of an area within business. Students in the program must complete a thesis. This program is also a suitable vehicle for students planning to pursue a Ph.D. in business.

Double degree programs are offered with architecture (M.Arch./M.B.A.), community and regional planning (M.B.A./M.C.R.P), and statistics (M.B.A./M.S.-Statistics). Various departments in the College of Business participate in the following graduate level interdepartmental offerings: Industrial Relations (interdepartmental program), Transportation (interdepartmental major), Gerontology (interdepartmental minor), and Technology and Social Change (interdepartmental program). The College of Business also offers a business administration minor to students with majors outside the college.



Mark C. Engelbrecht, Dean
Mark J. Chidister, Associate Dean
Roger E. Baer, Assistant Dean
Timothy O. Borich, Assistant Dean

Departments of the College

Architecture
Art and Design
Community and Regional Planning
Landscape Architecture

The College of Design is among a small, elite number of comprehensive design schools offering outstanding opportunities for both disciplinary and interdisciplinary education.

The College of Design strives to provide each student with a broad educational background and preparation in a specific environmental design or art discipline. Each program is designed to develop knowledge and appreciation of the physical and cultural environment, to stimulate creative thinking and analysis, and to prepare students for participation in a wide variety of careers.

The college's undergraduate curricula are structured along three areas: general education, general design education, and discipline-specific education. General education and general design education are composed to insure that students receive a well-rounded undergraduate education and exposure to allied design disciplines. The intense, discipline-specific course sequences focus on developing students' ability and knowledge in their major. Within the major area, students advance creative and professional skills through classroom and studio work, critiques of student projects, discussion with professional practitioners, and field studies.

The college's programs also encompass many opportunities for individualized study and extracurricular activities such as visiting lectures and symposia, workshops, gallery exhibits, practicum and internship programs, field trips, and international study programs. Graduates of the college are employed in private firms, government, industry, and education, or are self-employed as designers or artists. Opportunities for graduates include careers as architects, landscape architects, community and regional planners, graphic designers, interior designers, studio artists, arts administrators, art educators, and environmental designers.

The College's world wide web site includes additional information: www.design.iastate.edu

Undergraduate Curricula

Majors

Architecture
Art and Design
 Craft Design
 Drawing/Painting/Printmaking
 Visual Studies
Community and Regional Planning
Graphic Design
Interior Design
Landscape Architecture

Secondary Majors

Environmental Studies*
International Studies*
Transportation*

Minors

Design Studies
Entrepreneurial Studies
Environmental Studies*
Gerontology*
Housing*
International Studies*
Technology and Social Change*

*The College of Design participates in these interdepartmental second majors and minors.

Graduate Curricula

The College of Design offers graduate study in the areas shown below. Graduate study is conducted through the Graduate College. Details are found in the Graduate College section of this catalog.

Majors

Architecture
Architectural Studies
Art and Design
 Craft Design
 Drawing/Painting/Printmaking
 Intermedia
Art Education
Community and Regional Planning
Graphic Design
Interior Design
Landscape Architecture
Transportation Planning*

Double Degree Programs

Architecture/Planning
Planning/Landscape Architecture
Architecture/Business
Planning/Public Administration

Minors

Gerontology*
Housing*

*The College of Design participates in these interdepartmental graduate minors and major.

High School Preparation

Courses in fine arts and design that develop visualization and freehand drawing abilities are highly recommended though not required for

entrance. Students planning to enroll in an academic program of the College of Design must complete the following high school course requirements: 4 years of English to develop communication skills, critical reading and writing ability, including coursework in composition and literature, and, up to 1 year of speech and/or journalism; 3 years of mathematics to develop problem solving skills, including 1 year each of algebra, geometry, and advanced algebra; 3 years of science, including at least two of the following: 1 year of biology, 1 year of chemistry, or 1 year of physics; 2 years of social studies, including at least 1 year of U.S. history and 1 semester of U.S. government.

Special Requirements

Students admitted into the departments of Architecture and Landscape Architecture are enrolled in preprofessional programs. Admission into the professional programs requires a separate application after completing the preprofessional program, depends on available resources, and is subject to review by faculty committee. Applicants must complete a specified core of courses and are reviewed on the basis of a portfolio of original work, scholastic performance, and a written essay.

Students enrolled in all curricula in the Department of Art and Design must complete a set of basic course requirements before entering a specific program of study. Admission into the graphic design and interior design curricula depends on available resources. Applicants are reviewed on the basis of a portfolio of original work, scholastic performance, and a written composition.

Advising

Each student receives personal assistance from an academic adviser within the student's curriculum area. Students enrolled in the college's preprofessional programs are advised by professional advisers. Once admitted to professional programs, students are assigned to faculty advisers. Advisers help students develop a program of study, access pertinent university resources, as well as provide information on career choice.

The college's career services office works with students to develop their career goals as well as prepare and search for employment.

Honors Program

The College of Design participates in the Honors Program which provides opportunities for outstanding students to individualize their programs of study. See *Index, Honors Program*.

Requirements in the College of Design

All students in the College of Design are expected to meet the following requirements of the college.

General Education

Cr.

6 min. Biological sciences, physical sciences and mathematics

Includes courses in the fields of agronomy, astronomy and astrophysics, biology, botany, chemistry, civil engineering, computer science, geology, mathematics, physics, statistics, and zoology.

9.5 min.

Communications

Engl 104*, 105*, Lib 160.

Includes courses in the fields of English (composition), and speech communication (interpersonal and rhetorical).

6 min. Humanities

Includes courses in the fields of classical studies, English (literature), foreign languages, history, philosophy, religious studies, as well as history/theory/literature courses in dance, music, theater, journalism, African American studies, American Indian studies, environmental studies, Latino/a studies, women's studies, and university studies.

6 min. Social sciences

Includes courses in the fields of African American studies, American Indian studies, anthropology, economics, environmental studies, geography, human development and family studies, Latino/a studies, political science, psychology, sociology, and women's studies.

9 min. Selected from the above areas.

Six credits must be at the 300 level or above.

36.5 Total credits

See departmental curricula for specific course requirements within the general education areas.

General Design Education

Cr.

3 History requirement:

A history course in the College of Design but outside the student's curriculum area.

6-9 Options in studio, history, theory, criticism, and methods

Two studio, history, theory, criticism, and/or methods courses in the College of Design outside the student's curriculum area.

9-12 Total credits (at least 3 credits must be at the 300 level or above)

*To meet requirements for graduation, a minimum grade of C- must be received.

Minor in Design Studies

The undergraduate minor in Design Studies is constructed to facilitate design awareness among interested students and to provide a vehicle for interdisciplinary study within the College of Design. This minor is open to all undergraduate students at Iowa State University.

This minor requires fifteen credits of course work:

three credits of history selected from College of Design course offerings and twelve additional credits selected from College of Design course offerings.

At least six of the fifteen credits must be taken at Iowa State University in courses numbered 300 or above. At least nine of the fifteen credits must not be used to meet any other college or university requirements except the credit requirement for graduation.

Students enrolled in the College of Design may not use courses in their major to satisfy this minor.

Curriculum in Architecture

The department offers undergraduate and graduate degree programs:

A 140-credit undergraduate professional program, preceded by a 29.5-credit preprofessional program, leading to the bachelor of architecture degree.

A three-part 100-credit program leading to the master of architecture. Applicants holding B.S. or B.A. degrees in architecture or environmental design are given advanced standing in this program. For applicants holding professional degrees in architecture (B.Arch. or M.Arch.), a 30-credit post-professional course of study is available.

A 30-credit graduate program leading to the degree master of science in architectural studies, a research oriented degree.

For more complete graduate program descriptions see Graduate Study under Architecture in the Courses and Programs section.

Students are advised to seek faculty counsel regarding a career in architecture. Most states require that an individual intending to become an architect hold an accredited degree. There are two types of degrees that are accredited by the National Architectural Accrediting Board: (1) The bachelor of architecture, which requires a minimum of five years of study, and (2) the master of architecture, which requires a minimum of three years of study following an unrelated bachelor's degree or two years following a related preprofessional bachelor's degree. These professional degrees are structured to educate those who aspire to registration or licensure as architects.

The four-year preprofessional degree, where offered, is not accredited by the NAAB. The preprofessional degree is useful as preparation for further study in a professional architecture degree program or for employment options in a related field.

Preprofessional Program

First Year

Cr.	Fall/Spring
4	Arch 102
3	Arch 182
6	Engl 104/105
3	Math 142
4	Physics 111
6	Social sciences/humanities options*
3	Elective
0.5	Lib 160
29.5	

Professional Program

Second Year

Cr.	Fall
6	Arch 201
2	Arch 230
3	Arch 221
4	Arch 240
3	Social science/humanity option*
18	
Cr.	Spring
6	Arch 202
2	Arch 232
3	Arch 222
4	Arch 242
3	Arch 271
18	

Third Year

Cr.	Fall
6	Arch 301
3	Arch 357
3	Arch 344
3	Arch 371
3	Social science/humanity option*
18	
Cr.	Spring
6	Arch 302
3	Arch 372
3	Arch 346
3	Arch HTC option*
3	Elective*†
18	

Fourth Year

Cr.	Fall
6	Arch 401
3	Arch 458
3	Arch 448
3	Communication option*
3	Elective*†
18	
Cr.	Spring
6	Arch 402**
3	Professional option*†
3	Arch HTC option*
6	Electives*†
18	

Fifth Year

Cr.	Fall
6	Arch 403
2	Arch 485
3	Professional option*†
3	College option*
3	Elective*
17	
Cr.	Spring
6	Arch 404
3	College option*
3	Professional option*†
3	Elective*
15	

*Choose from a faculty approved list of courses.

**May be substituted by Dsn S 446 (Interdisciplinary Design Studio).

†Three credits of professional options or electives must satisfy the College of Design studio, theory requirement.

Curriculum in Art and Design—B.F.A.

Leading to the degree bachelor of fine arts.
Total credits required: 120.5.

This curriculum offers three concentrations for the student: (1) craft design (metalsmithing, fiber, and wood), (2) drawing/painting/printmaking, and (3) visual studies (calligraphy, computer-aided art and design, illustration, photography, two- and three-dimensional mixed media).

Admission into the art and design B.F.A. curriculum is subject to completion of a minimum of 24.5 credits including Art 108, 109, 110, 130, Dsn S 121, Engl 104 and 105, Lib 160, and 6 credits in general education coursework.

Transfer students with studio credits from other colleges and universities must present for departmental review a portfolio of work done in those courses in order to have the credits apply toward studio requirements. Students are advised to present this portfolio



of work upon admission and prior to registration for classes.

Cr. Degree Requirements

36.5 General education

6 min. Biological and physical sciences and mathematics

Select from Astro 120, 150, Biol 109, 123, 201, 202, Bot 102, 202, Chem 160, 163, 163L, Com S 103, 107, Geol 100, 101, Gen 260, Math 104 or 150, 105, 140, 141, 151, Mteor 206, Phys 101, 106, Stat 101, 104, Zool 155, 258, or any higher level course in these disciplines for which these courses are prerequisite

9.5 min. Communications

6 Engl 104 and 105
3 Select from CmDis 286, ComSt 101, 102, Sp Cm 212

0.5 Lib 160

6 min. Humanities

Select from Af Am 201, 252, Am In 310, Cl St—all courses, Dance 270, 360, Engl 201, 230, 231, 237, 335, 340, 346, 347, 348, 353, 354, 360, 361, 362, 363, 364, 373, 374, 375, 376, 377, 378, 379, 384, 389, F Lng 101, 102, 110, 201, 202, 301, 302, Hist—all courses, Music 102, 103, 104, 381, 383, 384, 472, Phil—all courses, Relig—all courses, T C 354, 355, Thre 106, 110, 252, 465, 466, W S 336, 340, 345, 370, 364, 377, 422

6 min. Social sciences

Select from Anthr 201, 202, 306, Econ 101, 102, Pol S 215, 230, 241, 251, 307, Psych 101, 230, Soc 130 or 134, or any higher level course in these disciplines for which these courses are prerequisite, or select from Am In 210, C R P 253, 270, 293, Env S 201, 223, HD FS 102, 239, 276, 283, 349, 367, 370, 373, 377, 378, 380, 395, JI MC 101, 205, 320, 453, 474, 476, W S 201, 301, 321, 323, 327, 346, 350, 385, 386, 401

9 min. Selected from the above areas and/or from Arch 420, 421, 422, 423, 424, 425, 426, 427, CmDis 275, 286, ComSt 101, 102, 214, 310, 311, 314, 317, 318, Engl 205, 219, 220, 302, 303, 304, 305, 306, 309, 310, 314, 315, 316, Fin 351, 357, L A 271, Mgmt 370, Mkt 340, Sp Cm 212, 305, 312, 321, 322, 323, 325, 327.

Six credits must be at the 300 level or above.

6 min. General design education*

3 History of Design—Dsn S 121**
3 Select from Dsn S 129, 201, 426, or other approved course from Arch, Art H, C R P or L A.

24 Art and design core

6 Visual Foundations I and II—Art 108, 109

R Orientation to Art and Design—Art 110
6 Drawing I and II—Art 130, 230
6 History of Art I and II—Art H 280, 281
6 Art history selections (300 level or above)

*The general design education requirement of 3 to 6 credits will be fulfilled within the studio requirement of the individual concentration.

**Transfer students with more than 60 credits must substitute another design studies course to meet this requirement.

Craft Design Concentration

15 Concentration requirements
3 Wood Design I—ArtCD 220
3 Ceramics I—ArtCD 222
3 Jewelry and Decorative Metalsmithing I—ArtCD 227
3 Select from Fiber Forms—ArtCD 343, Weaving—ArtCD 344, Fiber and Fabric Design—ArtCD 345, Resist and Dyed Fabric Design—Art CD 346, Printed Fabric Design—ArtCD 347
3 Select other ArtCD course
18 Studio options*
Select from ArtCD courses or ArtDP or ArtVS courses
3 Select art history or studio course
18 Electives
120.5 Total credits

*A minimum of 3 studio credits must be from outside the craft design area to fulfill general design education requirement.

Drawing/Painting/Printmaking Concentration

15 Studio requirements
Select 5 different courses from among the following: Painting I—ArtDP 238, Drawing III: Life Drawing—ArtDP 330, Painting II—ArtDP 338, Lithography—ArtDP 358, Intaglio—ArtDP 359, Drawing IV—ArtDP 430
18 Studio options*
Select from ArtDP courses or ArtCD or ArtVS courses
3 Select art history or studio course
18 Electives
120.5 Total credits

*A minimum of 3 studio credits must be from outside the drawing/painting/printmaking area to fulfill general design education requirement.

Visual Studies Concentration

14-15 Studio requirements
3 Select from Sources of Visual Design—ArtVS 300, Two-Dimensional Mixed Media—ArtVS 305, Three-Dimensional Mixed Media—ArtVS 306
11-12 Select from three-dimensional studio courses or a combination of three-dimensional and two-dimensional studio courses**

- 18 **Studio options***
Select from ArtVS, ArtCD, and ArtDP courses. It is strongly suggested that the student focus studio courses in two or three areas.
- 3 **Select art history or studio course**
- 18-19 **Electives**
- 120.5 **Total credits**

*One course will be considered the studio course fulfilling the 3 to 6 credit general design education studio requirement.

**Specific course information in relation to this requirement available in department office.

Curriculum in Art and Design—B.A.

Leading to the degree bachelor of arts. Total credits required: 120.5.

This curriculum offers a general concentration in studio and/or art history in combination with a second major, minor, and/or approved program outside the department.

Admission into the art and design B.A. curriculum is subject to completion of a minimum of 24.5 credits including Art 108, 109, 110, 130, Engl 104 and 105, Lib 160, 3 credit selected general design education course, and 6 credits in general education coursework.

Transfer students with studio credits from other colleges and universities must present for department review a portfolio of work done in these courses in order to have the credits apply toward studio requirements. Students are advised to present this portfolio of work upon admission and prior to registration for classes.

Cr. Degree Requirements

36.5 General education

6 min. Biological and physical sciences and mathematics

Select from Astro 120, 150, Biol 109, 123, 201, 202, Bot 102, 202, Chem 160, 163, 163L, Com S 103, 107, Geol 100, 101, Gen 260, Math 104 or 150, 105, 140, 141, 151, Mteor 206, Phys 101, 106, Stat 101, 104, Zool 155, 258, or any higher level course in these disciplines for which these courses are prerequisite

9.5 min. Communications

- 6 Engl 104 and 105
- 3 Select from CmDis 286, ComSt 101, 102, Sp Cm 212

0.5 Lib 160

6 min. Humanities

Select from Af Am 201, 252, Am In 310, Cl St – all courses, Dance 270, 360, Engl 201, 230, 231, 237, 335, 340, 346, 347, 348, 353, 354, 360, 361, 362, 363, 364, 373, 374, 375, 376, 377, 378, 379, 384, 389, F Lng 101, 102, 110, 201, 202, 301, 302, Hist—all courses, Music 102, 103, 104, 381, 383, 384, Phil—all courses, Relig—all courses, T C 354, 355, Thre 106, 110, 252, 465, 466, W S 336, 340, 345, 370, 374, 377, 422

6 min. Social sciences

Select from Anthr 201, 202, 306, Econ 101, 102, Pol S 215, 230, 241, 251, 307, Psych 101, 230, Soc 130 or 134, or any higher level course in these disciplines for which these courses are prerequisite, or select from Am In 210, C R P 253, 270, 293, Env S 201, 223, HD FS 102, 239, 276, 283, 349, 367, 370, 373, 377, 378, 380, 395, JI MC 101, 205, 320, 453, 474, 476, W S 201, 301, 321, 323, 327, 346, 350, 385, 386, 401

9 min. Selected from the above areas

and/or from Arch 420, 421, 422, 423, 424, 425, 426, 427, CmDis 275, 286, ComSt 101, 102, 214, 310, 311, 314, 317, 318, Engl 205, 219, 220, 302, 303, 304, 305, 306, 309, 310, 314, 315, 316, Fin 351, 357, L A 271, Mgmt 370, Mkt 340, Sp Cm 212, 305, 312, 321, 322, 323, 325, 327.

Six credits must be at the 300 level or above.

6 min. General design education**

- 3 Select a history course from Arch, Art H, Dsn S, or L A.
- 3 Select from Dsn S 121, 129, 201, 426, 446, or other approved design studies course
- 24 **Art and design core**
- 6 Visual Foundations I and II—Art 108, 109
- R Orientation to Art and Design—Art 110
- 6 Drawing I and II—Art 130, 230
- 6 History of Art I and II—Art H 280, 281
- 6 Art history selections (300 level or above)
- 9 **Art and design options****
Select from art history, craft design, drawing/painting/print-making, visual studies.
- 30 **Second major or minor, * and/or approved program****
- 15 **Electives**
- 120.5 **Total credits**

*A second major or minor must be approved by the department offering the program of study. See university guidelines for structuring and declaring a second major and/or minor. Credit hours not applied toward a formal second major or minor must be used in a coherent program approved by the Department of Art and Design. Approval for these 30 credits must be documented in writing following completion of 75 credits and before completion of 100 credits toward the B.A. degree.

**The general design education studio, history, theory and criticism courses requirement of 3 to 6 credits will be fulfilled within the art and design options or within the approved program.

Curriculum in Community and Regional Planning

Leading to the degree bachelor of science. Total credits required: 128.5.

Areas of concentration include: housing, urban design, planning management and implementation, planning in developing countries, social planning, transportation planning, environmental planning, community and rural development, and land use planning.

Cr. Degree Requirements

12.5 Communications

Engl 104, 105; and 309 or 314; Lib 160; Sp Cm 212

9 Humanities

7 Mathematics

Stat 101, Math

6 Natural sciences

18 **Social sciences**
Econ 101 or 102; Pol S 215; Soc 134; options

9 Design core

LA 101; General design education,** or from approved options

3 Engineering and transportation options

C E 350

40 Community and regional planning core

C R P 253, 272, 274, 383, 432, 492; options

14 Planning related specialty

10 Electives

128.5 Total credits

**See College of Design requirements.



Curriculum in Graphic Design

Administered by the Department of Art and Design. Leading to the bachelor of fine arts degree. Total credits required for graduation: 123.5. Curriculum is planned for students preparing to enter the professional field of graphic design.

Consideration for admission into the graphic design curriculum requires completion of at least one year of study at ISU. Admission is based on department resources and will be determined by overall cumulative grade point average following completion of 23 credits including the following courses: Art 108, 109, 110, 130, ArtGr 177, DsnS 121, Engl 104 or 105, and 6 credits of general education. A portfolio review also will be a primary factor in the admission review process.

Transfer students with studio credits from other colleges and universities must present for departmental review a portfolio of work done in these courses in order to have the credits apply toward studio requirements. Students are advised to present this portfolio of work upon admission and prior to registration for classes.

Cr. Degree Requirements

39.5 General education

6 min. Biological and physical sciences and mathematics

Select from Astro 120, 150, Biol 109, 123, 201, 202, Bot 102, 202, Chem 160, 163, 163L, Com S 103, 107, Geol 100, 101, Gen 260, Math 104 or 150, 105, 140, 141, 151, Mteor 206, Stat 101, 104, Phys 101, 106, Zool 155, 258, or any higher level course in these disciplines for which these courses are prerequisite

9.5 min. Communications

6 Engl 104 and 105
3 Select from CmDis 286, ComSt 101, 102, Sp Cm 212

0.5 Lib 160

6 min. Humanities

Select from Af Am 201, 252, Am In 310, Cl St – all courses, Dance 270, 360, Engl 201, 230, 231, 237, 335, 340, 346, 347, 348, 353, 354, 360, 361, 362, 363, 364, 373, 374, 375, 376, 377, 378, 379, 384, 389, F Lng 101, 102, 110, 201, 202, 301, 302, Hist—all courses, Music 102, 103, 104, 381, 383, 384, 472, Phil—all courses, Relig – all courses, T C 354, 355, Thtr 106, 110, 252, 465, 466, W S 336, 340, 345, 370, 374, 377, 422

6 min. Social sciences

Select from Anthr 201, 202, 306, Econ 101, 102, Pol S 215, 230, 241, 251, 307, Psych 101, 230, Soc 130 or 134, or any higher level course in these disciplines for which these courses are prerequisite, or select from Am In 210, C R P 253, 270, 293, Env S 201, 223, HD FS 102, 239, 276,

283, 349, 367, 370, 373, 377, 378, 380, 395, JI MC 101, 205, 320, 453, 474, 476, W S 201, 301, 321, 323, 327, 346, 350, 385, 386, 401

12 min. Selected from the above areas and/or from Arch 420, 421, 422, 423, 424, 425, 426, 427, CmDis 275, 286, ComSt 101, 102, 214, 310, 311, 314, 317, 318, Engl 205, 219, 220, 302, 303, 304, 305, 306, 309, 310, 314, 315, 316, Fin 351, 357, L A 271, Mgmt 370, Mkt 340, Sp Cm 212, 305, 312, 321, 322, 323, 325, 327.

Six to nine credits must be at the 300 level or above.

6 min. General design education**

3 History of Design—DsnS 121*
3 Select a history course from Arch, Art H, Dsn S, or L A.

24 Art and design core

6 Visual Foundations I and II—Art 108, 109
R Orientation to Art and Design—Art 110
6 Drawing I and II—Art 130, 230
6 History of Art I and II—Art H 280, 281

6 Studio options**

Select from ArtCD, ArtDP, ArtVS or other approved studio course

48 Graphic design concentration

2 Introduction to Graphic Design—ArtGr 177
3 Design Through Photography—ArtVS 229 or Fundamentals of Photographic Technique—JI MC 310
6 Graphic Design Studio I and II—ArtGr 270, 271
4 Graphic Technology I and II — ArtGr 275, 276
1 Graphic Design Internship Seminar—ArtGr 277
6 Graphic Design Studio III and IV—ArtGr 370, 371
6 Graphic Design History/Theory/Criticism I and II, ArtGr 387, 388
6 Graphic Design Studio V and VI—ArtGr 470, 471
8 Select four 2 credit options from approved department list. One option will be taken with ArtGr 370, 371, 470 and 471***.
3 Select from Graphic Design in Europe—Art 495G, Graphic Design Internship—ArtGr 480
3 Graphic Design Professional Practices—ArtGr 481

6 Electives

123.5 Total credits

*Transfer students with more than 60 credits must substitute another design studies course to meet this requirement.

**The general design education studio, history, theory and criticism courses requirement of 3 to 6 credits will be fulfilled within the 6 credit studio options requirement.

***Three credits of ArtGr 477 may be substituted for one of the two credit options.

Curriculum in Interior Design

Administered by the Department of Art and Design. Leading to the bachelor of fine arts degree. Total credits required for graduation: 127.5. Curriculum is planned for students preparing to enter the professional field of interior design.

Consideration for admission into the interior design curriculum requires completion of at least one year of study at ISU. Admission is based on department resources and will be determined by rank order, based on three factors: A. Overall cumulative grade point average following completion of 27 credits including the following courses: Art 108, 109, 110, 130, ArtID 167, DsnS 121, Engl 104 or 105, and 6 credits of general education; B. A written composition and; C. Portfolio review.

Transfer students with studio credits from other colleges and universities must present for departmental review a portfolio of work done in these courses in order to have the credits apply toward studio requirements. Students are advised to present this portfolio of work upon admission and prior to registration for classes.

Cr. Degree Requirements

36.5 General education

6 Biological and physical sciences and mathematics

3 Math 104 or 105 or 140 or 150
3 Select from Astro 120, 150, Biol 109, 123, 201, 202, Bot 102, 202, Chem 160, 163, 163L, Com S 103, 107, Geol 100, 101, Gen 260, Math 104 or 150, 105, 140, 141, 151, Mteor 206, Phys 101, 106, Stat 101, 104, Zool 155, 258, or any higher level course in these disciplines for which these courses are prerequisite

9.5 Communications

6 Engl 104 and 105
0.5 Lib 160
3 Select from CmDis 286, ComSt 101, 102, Sp Cm 212

6 Humanities*

Select from Af Am 201, 252, Am In 310, Cl St – all courses, Dance 270, 360, Engl 201, 230, 231, 237, 335, 340, 346, 347, 348, 353, 354, 360, 361, 362, 363, 364, 373, 374, 375, 376, 377, 378, 379, 384, 389, F Lng 101, 102, 110, 201, 202, 301, 302, Hist—all courses, Music 102, 103, 104, 381, 383, 384, 472, Phil—all courses, Relig – all courses, T C 354, 355, Thtr 106, 110, 252, 465, 466, W S 336, 340, 345, 370, 374, 377, 422

6 Social sciences*

Select from Anthr 201, 202, 306, Econ 101, 102, Pol S 215, 230, 241, 251, 307, Psych 101, 230, Soc 130 or 134, or any higher level course in these disciplines for which these courses are prerequisite, or select from Am In 210, C R P 253, 270, 293, Env S

201, 223, HD FS 102, 239, 276, 283, 349, 367, 370, 373, 377, 378, 380, 395, JI MC 101, 205, 320, 453, 474, 476, W S 201, 301, 321, 323, 327, 346, 350, 385, 386, 401

9 min. Select from the above areas and/or Arch 420, 421, 422, 423, 424, 425, 426, 427, CmDis 275, 286, ComSt 101, 102, 214, 310, 311, 314, 317, 318, Engl 205, 219, 220, 302, 303, 304, 305, 306, 309, 310, 314, 315, 316, Fin 351, 357, L A 271, Mgmt 370, Mkt 340, Sp Cm 212, 305, 312, 321, 322, 323, 325, 327.

Six credits must be at the 300 level or above.

- 6 **General design education**
- 3 History of Design—DsnS 121**
- 3 Select a history course from Arch, Art H, DsnS, or L A.
- 15 **Art and design core**
- 6 Visual Foundations I and II—Art 108, 109
- R Orientation to Art and Design—Art 110
- 3 Drawing I—Art 130,
- 6 Studio selection***
Select from ArtCD, ArtDP, ArtVS
- 67 **Interior design concentration**
- 3 Interior Design Foundations—ArtID 160
- 3 Graphic Communication for Interior Designers—ArtID 161
- 3 Textile Fundamentals—T C 104
- 8 Interior Design Studio I and II, ArtID 265, 267
- 3 Interior Design Computer Applications—ArtID 269
- 4 Materials and Assemblies I—Arch 240 or Interior Systems I—ArtID 350
- 9 Interior Systems II, III, and IV—Art ID 351, 352, 353
- 6 Interior Design History/Theory/Criticism I and II—ArtID 355, 356
- R Junior Field Study—ArtID 359
- 8 Interior Design Studio III and IV—ArtID 365, 367
- 1 Interior Design Internship Seminar—ArtID 369
- R Senior Field Study—ArtID 459
- 3 Interior Design Internship—ArtID 460
- 2 Interior Design Professional Practices—ArtID 461
- 8 Interior Design Studio V and VI—Art ID 465, 467
- 6 Select Arch, ArtCD, ArtDP, ArtID, ArtVS, CRP, DsnS, LA course or Mgmt 370 or Mkt 340
- 3 **Electives**

127.5 Total credits

*Sequence of two humanities courses or social sciences courses required as part of general education.

**Transfer students with more than 60 credits must substitute another design studies course to meet this requirement.

***Course fulfills both art and design department requirement and general design education requirement of 3 to 6 credits.

Curriculum in Landscape Architecture

The department offers a 5-year curriculum, requiring 149.5 credits, leading to the degree bachelor of landscape architecture. These credits are distributed between a one-year pre-professional program of 32.5 credits and a 4-year professional program of 117 credits.

Admission into the professional program depends upon available resources and is subject to the approval of a faculty committee at the completion of the preprofessional program. Applicants must complete a specified core of courses and are reviewed on the basis of a portfolio of original work, scholastic performance, and a written essay.

Preprofessional Program

First Year

- | Cr. | Fall |
|------|--|
| 4 | Landscape Architectural Design and Visualization I—LA 101 |
| 3 | Introduction to Landscape Architecture—L A 141 |
| 3 | First-Year Composition—Engl 104 |
| 3 | Algebra—Math 140 |
| 3 | Environmental Biology—Env S 123 |
| 16 | |
| Cr. | Spring |
| 4 | Landscape Architectural Design and Visualization II—LA 102 |
| 3 | Design option ¹ |
| 3 | Trigonometry—Math 141 |
| 3 | Soils for Urban Use—Agron 156 |
| 3 | First Year Composition II—Engl 105 |
| 0.5 | Library Instruction—Lib 160 |
| 16.5 | |

Second Year

- | Cr. | Fall |
|-----|---|
| 6 | Midwestern Landscape Studies—L A 201 |
| 2 | Investigating Landscape Constructions—LA 281 |
| 3 | Native Plants of the Midwest—LA 221 |
| 3 | Introduction to Landscape Architectural Theory—LA 272 |
| 14 | |
| Cr. | Spring |
| 6 | Site Planning and Design I—L A 202 |
| 3 | Landscape Architectural History: prehistory to 1900—L A 273 |
| 3 | Human Behavior and Environment Theory—Arch 271 |
| 3 | Literature option ¹ |
| 3 | Elective |
| 18 | |

Professional Program

Third Year

- | Cr. | Fall |
|-----|--|
| 6 | Site Planning and Design II—L A 301 |
| 3 | Introduced Plants of the Midwest—L A 321 |
| 3 | Craft Design option ¹ |

- 3 Landscape Architectural History: 1900 to present—L A 371
- 3 Elective
- 18

Cr. Spring

- 6 Regional Landscape Design—L A 302
- 1 Contemporary Landscape Architecture—LA 341
- 2 Shaping the Land—L A 381
- 3 Environmental Law—Env S 491
- 3 Environmental Sociology—Env 382
- 2 Elective
- 17

Fourth Year

Cr. Fall

- 6 Community Landscape Design—L A 401
- 2 Landscape Construction—L A 481
- 3 Environmental Ethics—Env S 334
- 1 Landscape Architecture Professional Internship, Study Abroad, National Exchange Seminar—L A 450
- 3 Communication option¹
- 15

Cr. Spring

- R Landscape Architecture Professional Internship, Study Abroad, National Exchange—L A 451

Fifth Year

Cr. Fall

- 6 Urban Landscape Design—L A 402
- 3 Professional Practice—L A 441
- 2 Advanced Landscape Construction—L A 482
- 2 Optional Senior Thesis Preparation Tutorial (prerequisite for senior thesis)—L A 403
- 4 Elective
- 17

Cr. Spring

- 6 Advanced Landscape Architectural Design Options—L A 404 or Senior Thesis—L A 405
- 3 Landscape Architectural History/Theory/Criticism—L A 471
- 3 History option¹
- 6 Electives
- 18

149.5 Total credits

1. Select from department approved list.

At least two elective courses must be from an L A professional elective list approved by the department.

Graduate students pursuing the M.L.A. may concurrently enroll in the undergraduate program to earn the B.L.A. The actual courses required will vary according to each student's landscape architectural skill level upon admission as determined by a faculty committee. For more information, students should contact the department office.

Walter Gmelch, Dean
 Larry H. Ebbers, Associate Dean
 Shirley J. Wood, Interim Associate Dean

Departments of the College

Curriculum and Instruction
 Educational Leadership and Policy Studies
 Health and Human Performance
 Industrial Education and Technology

The College of Education provides degree programs leading to licensure in early childhood, elementary education and physical education as well as a professional sequence of courses for students at Iowa State seeking a teaching license. In addition, the college offers several degree programs in nonteaching fields, such as Industrial Technology, Community Health Education and Exercise and Sport Science. Certain professional programs are also available at the graduate level, including licensure programs for community college teaching, school superintendent, elementary and secondary principals, school media specialists, special education and school counseling.

A person who is to work effectively with people needs broad personal and professional knowledge and understanding. The College of Education strives to provide each student with a sound general education as well as preparation in an area of specialization.

In addition, a prospective teacher must have an understanding of teaching and of learning, and skill in applying such understanding in the classroom. An awareness of the characteristics of growth and development of students and the role of learning in society is also needed.

Recommended High School Preparation

Recommended preparation for students entering most departments of the College of Education should include 4 years of English (including speech) with emphasis in composition and communication skills; 3 years each of mathematics and natural sciences, and 3 years of social science and/or humanities.

Advising System

Each student in the College of Education works closely with an academic advisor who is associated with the curriculum in which the student is majoring. Advisors assist students in developing academic programs and in adjusting to university life. They also provide information and guidance about career choices. Advisors attempt to adjust each student's schedule of course work in accordance with the student's interests and capabilities.

The college offers an orientation program during the summer for students planning to enter in the fall. Incoming students are encouraged to attend the orientation session so that academic assessments can be made and appropriate classes may be scheduled for the following term.

Curricula and Special Programs in the College of Education

Curriculum and Instruction

Community Health Education—Options: Community and Public Health, Substance Abuse Prevention, Wellness/Fitness.

Early Childhood Education—(Administered jointly by the Department of Curriculum and Instruction in the College of Education and the Department of Human Development and Family Studies in the College of Family and Consumer Sciences.)

Elementary Education.

Exercise and Sport Science—Options: Athletic Training, Exercise Science, General Exercise and Sport Studies, Physical Education Licensure, Sport Management.

Industrial Technology—Options: Manufacturing, Occupational Safety, Training and Development.

Secondary Education. The College of Education provides secondary education licensure programs in conjunction with subject matter areas of agriculture, art (master's program only), biology, chemistry, earth sciences, English, foreign languages, general sciences, health, family and consumer sciences education, mathematics, music, physical science, physics, social studies, and speech. See *Index, Teacher Education*.

The College of Education offers coaching and health endorsements to students who want to add additional teaching areas to their primary licensure program.

Minors

Athletic Coaching
 Athletic Training
 Dance
 Educational Computing
 Health Studies

Graduate Curricula

Graduate study in the College of Education is conducted through the Graduate College. Details are found in the Graduate College section of this bulletin.

Honors Program

The College of Education Honors Program provides an opportunity for students with a 3.35 grade point average or higher to complete their course of study in the University Honors Program. For more details, contact the academic advisor, the College Honors Committee, or see *Index, Honors Program*.

International Studies (secondary major only)

The International Studies Program is an interdisciplinary program which may be taken only as a second major. Students pursuing a second major in international studies must complete the International Studies Program as described in this catalog (see *Index, International Studies*).

The General Education Requirement

Students in the College of Education and all prospective teachers are required to complete a program in general education which is integrated with their professional training and extends through the undergraduate curriculum.

The general education program emphasizes intellectual growth and personal development as contrasted with specific vocational preparation. It is recognized that many contributions to general education may be made by courses which have other primary objectives.

The program aims to stimulate a desire for learning and intellectual endeavor, develop understanding and appreciation for the physical and cultural world, encourage independent thinking and analysis, increase competence in all aspects of communication, and create an understanding of individuals as social, psychological, and physical beings.

The student is expected to complete studies in five groups in general education. Areas represented below are not departmental titles. In some cases, courses relating to a given area may be found in several different departments. Credits listed are minimum requirements.

Cr.	
9	I. Biological sciences, physical sciences, and mathematics
9	II. Social sciences
6	III. Humanities
9	IV. Communication skills
1	V. Health, dance, physical education, safety
34	
8	Additional credits in above areas
42	

This total will include Engl 104 and 105, Lib 160, and credits used to satisfy University requirements in the areas of U.S. Diversity and International Perspectives.

Teacher Education and Licensure

All students who are recommended by Iowa State University for teacher licensure must meet the requirements of the teacher education program and be recommended by the College of Education.

Each student will be enrolled in the department in which he or she plans to major and must meet the graduation requirements of that department and the college in which it is located.

For details concerning the professional teacher education requirements and the areas of specialization requirements, see *Teacher Education, Courses and Programs*.

Curriculum in Community Health Education

Administered by the Department of Health and Human Performance, the curriculum in community health education was developed to prepare professionals in diverse fields within health education. Students electing to major in Community Health Education may select one of three career options: 1. Community/public health; 2. Substance abuse prevention; or 3. Wellness/fitness. Various certifications are available upon successful completion of the options within the curriculum.

A minor in health studies is available; the requirements appear under Health and Human Performance, Courses and Programs.

For students preparing to teach grades 7-12, health studies may be added to their primary licensure area. See *Teacher Education*.

English Proficiency

In order to meet graduation requirements, all students must earn an average of C (2.0) or better in Engl 104 and Engl 105, with neither grade below a C-. Students not meeting this condition must earn a C or better in an advanced writing course (select from Engl 220, 302, 309, or 314).

U.S. Diversity and International Perspectives

In order to meet graduation requirements, all students must complete 3 credits of course work in U.S. Diversity and 3 credits in International Perspectives. See university approved list.

Total credits required: 124 (46 credits in courses number 300 or above.)

Cr.

- 48.5-49.5 General education**
21-22 Biological sciences, physical sciences and mathematics
- 4 Chem 163
 - 1 Chem 163L
 - 3 Principles of Biology—Biol 201
 - 3 Introduction to Human Nutrition—FS HN 167
 - 3-4 Computer Applications—C I 201 or Com S 103

- 3 Basic Human Physiology and Anatomy—Zool 155
- 4 **Principles of Statistics—Stat 101**
- 9 Social sciences**
- 3 Introduction to Sociology—Soc 134
- 3 Developmental Psychology—Psych 230 or Individual and Family Life Development—HD FS 102
- 3 Social Psychology—Psych 280 or Soc 305
- 6 Humanities**
Hist, Relig, Phil, F Lng, Engl Lit, CI St, (See HHP homepage or department list)
- 12.5 Communication skills**
- 6 First-year Composition—Engl 104, 105
- 3 Fundamentals of Public Speaking—Sp Cm 212
- 3 Business Communication—Engl 302 or Business and Professional Speaking—Sp Cm 312
- 0.5 Library Instruction—Lib 160
- 12 Community health core**
- 3 Foundations—H S 255
- 3 Community and Public Health—H S 310
- 3 Administration of School Health—H S 390
- 3 Community Health Program Development—H S 430
- 14 Community Health Education Content Courses**
- 2 First Aid and Emergency Care—H S 105
- 3 Personal and Consumer Health—H S 110
- R Health and Human Performance Orientation—H S 250
- 3 Drug Education—H S 215
- 3 Human Diseases—H S 350
- 3 Human Sexuality—HD FS 276
- R Job Search Skills and Strategies—H S 401
- 16 Community Health Supporting Courses**
- 3 Principles of Accident Prevention—I Tec 272
- 3 Principles of Microeconomics—Econ 101
- 3 Principles of Marketing—Mkt 340
- 3 Principles of Public Relations—JI MC 220 or Publicity Methods JI MC 205
- 2 Visual Principles for Mass Communicators—JI MC 342
- 2 Laboratory in Visual Principles—JI MC 342L

Option 1: Community/Public Health (21-23 cr.)

This option emphasizes health promotion and disease prevention and prepares students for professional involvement in community health agencies which incorporate health services and the educational process. Students will be prepared for employment in state and public health agencies, volunteer health agencies, hospitals (patient education), and industry (health and wellness programs). Graduates are eligible to take the National Certified Health Education Specialist (CHES) exam which recognizes qualified specialists in the diversified field of health education.

Cr.

- 2 Physical Fitness and Conditioning—Ex Sp 258
- 2 Lab in Human Physiology and Anatomy—Zool 156
- 2 General Microbiology—Micro 201
- 2 Introduction to Microbiology Lab—Micro 203
- 3 Aging and the Family—HD FS 377
- 10-12 Directed Field Experience in Community Health Education—H S 488
- 9.5-12.5 Electives

Option 2: Substance Abuse Prevention (24 cr.)

This option is designed to meet the needs of students who are interested in becoming certified substance abuse prevention specialists. To be eligible for Iowa Board of Substance Abuse Certification, students need 600 hours of an approved supervised internship within the CHE major. Preventionists are employed in state health departments, state education departments, school districts and private and public agencies which have prevention programs.

Cr.

- 3 Substance Abuse Prevention—H S 395
- 3 Youth and Crime—Soc 241
- 3 Children, Family & Public Policy—HD FS 395
- 3 Counseling Theories and Techniques—Psych 422
- 12 Directed Field Experience in Community Health Education—H S 488
- 8.5-9.5 Electives

Option 3: Wellness/Fitness (27-29 cr.)

The Wellness/Fitness option prepares students interested in career settings which emphasize health promotion and physical fitness. These include: business, industry, hospitals and recreation settings. This program allows students to combine wellness concepts from Community Health Education with fitness concepts from the field of exercise science.

Cr.

- 2 Physical Fitness and Conditioning—Ex Sp 258
- 2 Laboratory in Human Physiology and Anatomy—Zool 156
- 2 Leadership Techniques for Fitness—Ex Sp 259
- 3 Health Promotion in the Community and Workplace—Ex Sp 440
- 4 Physiology of Exercise—Ex Sp 455
- 3 Principles of Fitness Assessment & Exercise Prescription—Ex Sp 458
- 1 Internship in Exercise Leadership—Ex Sp 459
- 10-12 Directed Field Experience in Community Health Education—H S 488
- 3.5-6.5 Electives

Curriculum in Early Childhood Education

The curriculum in early childhood education is planned for students preparing to teach young children and work with their families. This program leads to careers in working with young children who are typically developing and those with special needs from birth through age eight. Graduates in this curriculum may teach in early childhood (preschool and primary) classrooms or home based programs, with emphasis on inclusive services; graduates may be employed by either public or private agencies including schools. This curriculum has been approved by the Iowa Department of Education and meets requirements for the early childhood education unified teacher license, which permits individuals to teach general and special education for children from birth through age eight. The program is jointly administered by the Department of Curriculum and Instruction within the College of Education and the Department of Human Development and Family Studies within the College of Family and Consumer Sciences.

English Proficiency

In order to meet graduation requirements, all students must earn a C (2.0) or better in Engl 104 and Engl 105.

U.S. Diversity and International Perspectives

In order to meet graduation requirements, all students must complete 3 credits of course work in U.S. Diversity and 3 credits in International Perspectives. See department advising office for approved lists of courses.

Total credits required: 128.5

Cr.	
44.5	General education
12.5	Communications and Library Engl 104 (3), 105 (3), Lib 160 (0.5), Sp Cm 212 (3), Options (3)
12	Natural sciences and Math Disciplines Biological sciences (3), Math 195 (3), physical sciences (3), FS HN 167
9	Social sciences American history or American government (3), options (6)
9	Humanities Select 9 credits from department- approved list
2	Health, dance, physical education, safety H S 105 (2)
12	Human development and family studies HD FS 102 (3), HD FS 220 (3), 221 (3); select 3 credits from HD FS 349, 395, 445, 449, 460
72	Professional education
14	Professional education core C I 201 (3), 204 (3), 333 (3), 406 (2); Sp Ed 250 (3); Orientation (R)



21	Preprimary: Inclusive HD FS 240 (3), 340 (4), 343 (4), 345 (3), 455 (4), 456 (3)
21	Primary: Inclusive C I 245 (2), 268 (1), 367 (4), 433 (2), 438 (2), 439 (2), 468F (1), 468G (1), 468I (1); Sp Ed 368 (1), 355 (2), 455 (2)
16	Student teaching: Preprimary and Primary (Inclusive) Sp Ed 415 (8) and HD FS 417B (8) or C I 416A (8) and HD FS 417C (8)

Curriculum in Elementary Education

The curriculum in elementary education is planned for students preparing to teach in grades kindergarten through six. For additional information, see *Index, Elementary Education*. Teaching endorsements in areas closely related to elementary education, including a special education endorsement in multicategorical resource teaching, are available for elementary education majors. See *Teacher Education, Courses and Programs*, for information about specific endorsements. Additional teaching endorsements, available at the graduate level to individuals who hold a valid Iowa teaching license, include the following: K-6 foreign language, reading, special education (behavior disorders, learning disabilities, multicategorical self-contained), and talented and gifted.

English Proficiency

In order to meet graduation requirements, all students must have a C (2.0) or better for each of Engl 104 and Engl 105.

U.S. Diversity and International Perspectives

In order to meet graduation requirements, all students must complete 3 credits of course work in U.S. Diversity and 3 credits in International Perspectives. See department for approved lists of courses.

Total credits required: 135.5.

Cr.	
46.5	General Education*
9.5	Communication skills Engl 104 (3), 105 (3); Library 160 (0.5); Select from ComSt 102 (3), 317 (3), 318 (3), Sp Cm 212 (3), 312 (3), 313 (3), 322 (3), 327 (3)
9	Social sciences Psych 230 (3), American history/American government (3), options (3)
9	Humanities Select 9 credits from department- approved list
1	Health, dance, physical education, safety options (1)
9	Mathematics Math 195 (3), 196 (3); Select from 140 (3), 142 (3), 160 (3), 165 (4), 180 (3), 295 (3).
9	Biological/Physical Sciences Biological sciences (3) select from Biol 109 (3), 201 (3); Bot 102 (2), 202 (2), 207 (4); Zool 155 (3), 156 (2), 258 (3) Physical sciences (3) select from Anthr 202 (3); Astro 120 (3), 150 (3); Chem 160 (3), 163 (4), 164 (4); Geol 100 (3), 100L (1), 101 (3), 103 (3), 106 (3); L A S 111 (4); Mteor 206 (3); Phys 101 (3), 106 (4)
18	Area of specialization (Requires 24 credits, including at least 6 in courses numbered 300 or above. A minimum of 18 credits may not be used to meet other require- ments.)
68	Professional education
23	Required courses 201 (3), 204 (3), 250 (3), 245 (2), 268 (1), 333 (3), 406 (2); HD FS 226 (3), 240 (3) or Engl 394 (3)
20	Required methods 377 (4), 468A (1), 378 (4), 468B (1), 448 (3), 468C (0.5), 449 (3), 468D (0.5), 443 (3)
3	Related Options Select from 302 (3), 422 (3), 450 (3), 451 (3), 457 (3); Sp Ed 330 (3); Cpr E/Mat E 370 (3); HD FS 367 (3); Sp Cm 275 (3); Thtre 359 (3); U St 225 (3); H S 105 (2); Psych 437 (3)
6	Related Methods Select from H S 275 (3); ArtEd 211 (3); Music 265 (3); Ex Sp 284 (3)
16	Student teaching 417A (8), 417B (8), Sp Ed 416 (special education students only)
3	Electives
R	Orientation (required) First year—115; sophomore— 215; transfer—315

*Refer to departmental curriculum sheet, available from adviser, for specific course requirements.

Curriculum in Exercise and Sport Science

The curriculum in Exercise and Sport Science is planned for students preparing to teach physical education or to enter related professional areas. The student majoring in Exercise and Sport Science may select one of five options: (1) physical education licensure; (2) exercise science; (3) athletic training; (4) sport management; or (5) general exercise and sport studies.

Minors in dance, athletic training, and athletic coaching are available; the requirements appear under *Health and Human Performance, Courses and Programs*.

A major in Performing Arts with a dance emphasis is available; the requirements appear under *Curriculum in Performing Arts in Theatre*.

English Proficiency

In order to meet graduation requirements, all students must earn an average of C (2.0) or better in Engl 104 and 105, with neither grade being lower than a C-. Students not meeting this condition must earn a C or better in an advanced writing course (select from Engl 220, 302, 309, or 314).

U.S. Diversity and International Perspectives

In order to meet graduation requirements, all students must complete 3 credits of course work in U.S. Diversity and 3 credits in International Perspectives. See university approved list..*

Total credits required: 124 (46 credits in courses numbered 300 or above).

Cr.	
42.5	General Education
9	Biological sciences, physical sciences, mathematics
3	Basic Human Physiology and Anatomy—Zool 155
2-3	Mathematics—select from Math 104, 140, 141, 142, 150,165**
3-4	Computer Science—select from Com S 103, 107, 205, C I 201
9	Social sciences
3	Introduction to Psychology—Psych 101
3	Introduction to Sociology—Soc 134
3	Choose from Soc, Psych, Econ, Anthr (See HHP homepage.)
6	Humanities
	Hist, Relig, Phil, F Lng, CI St Engl Lit (see HHP homepage or department list.)
12.5	Communication skills
6	First-year Composition—Engl 104, 105
3	Fundamentals of Public Speaking—Sp Cm 212
0.5	Library Instruction—Lib 160
3	English or Speech—select from Engl 302, 314, Sp Cm 312

- 3 Health, safety, physical education, and dance
- 3 Personal and Consumer Health—H S 110
- 3 Electives for Gen Ed.

*ISU homepage: Registrar, Diversity and International Perspectives

**Exercise Science majors must select Math 140, 141, 142, or 165

- 15-17 Core requirements***
- R Orientation to Health and Human Performance—Ex Sp 250
- 3-4 Biomechanics—Ex Sp 355**or Biomechanical Aspects of Human Movement—Ex Sp 356**
- 3 Sociology of Sport and Physical Activity—Ex Sp 360
- 3 Psychology of Sport and Physical Activity—Ex Sp 365
- 3 Motor Learning and Control—Ex Sp 372
- 3-4 Physiology of Exercise—Ex Sp 455**or Physiological Aspects of Human Movement—Ex Sp 456**

*A grade of C- or better in each of the required core courses must be earned prior to graduation.

**Students in Option 3, Exercise Science and Option 4, Athletic Training must take Ex Sp 355 and Ex Sp 455.

Option 1. Physical Education Licensure

This option is designed for students interested in becoming licensed to teach physical education in junior and/or senior high schools. Students who are interested in teaching elementary physical education must earn additional credits in Ex Sp 275, Ex Sp 280, Ex Sp 418, Dance 384, and HD FD 226. Students interested in preparing to coach must earn additional credits in: Ex Sp 220 and 315. Note: When making general education course selections, teacher licensure students must choose



C I 201, Psych 230, a physical science and a U.S. history or political science course.

- 26 Professional education requirements**
- 3 Educational Psychology—C I 333
- 3 Foundations of American Education—C I 204
- R Senior Seminar—C I 415
- 2 Multicultural Awareness and Nonsexism in the Classroom—C I 406
- 3 Principles of Secondary Education—C I 426
- 12 Supervised Teaching in Physical Education in the Secondary School—Ex Sp 417 (Reduce credits in Ex Sp 417 to 8 if concurrently enrolled in 418)
- 20 Physical education professional theory**
- 2 Physical Fitness and Conditioning—Ex Sp 258
- 1 Pre-Student Teaching Experience—C I 280, 280A
- 3 History of Sport and Physical Activity—Ex Sp 260
- 3 Teaching Physical Education—Ex Sp 375
- 2 Methods of Teaching Dance—Dance 385
- 3 Adapted Physical Education—Ex Sp 395
- 3 Evaluation in Physical Education—Ex Sp 470
- 3 Physical Education Curriculum Design and Program Organization—Ex Sp 475
- 12 Physical education professional activity and related courses**
- 3 Intro to Human Nutrition—FS HN 167
- 2 First Aid and Emergency Care—H S 105
- 1 Aquatics—Ex Sp 230
- 1 Tumbling and Gymnastics Skills—Ex Sp 231
- 3 Individual Sports—Ex Sp 235, 236, 237
- 3 Team Sports—Ex Sp 232, 233, 234
- 2 Dance—Dance 210, 211
- 8.5 Electives (If 7-12 only)**

K-12 Additional Courses

- 3 Movement Education in Elementary School Physical Education—Ex Sp 275
- 1 Directed Field Experience in Elementary School Physical Education—Ex Sp 280
- 2 Teaching Children's Dance—Dance 384
- 3 Development and Guidance in Middle Childhood—HD FS 226
- 8 Supervised Teaching in Physical Education in the Elementary School—Ex Sp 418

Option 2. Exercise Science

This option prepares students for careers in the physical fitness/health field. It is designed for those who wish to prepare for professional roles as exercise specialists or program directors in corporate fitness programs, health clubs, cardiac rehabilitation programs, or other

public and private agencies providing physical fitness activities.

- 43-53 Exercise Science Requirements**
- 2 Basic Athletic Training—Ex Sp 220
 - 2 Physical Fitness and Conditioning—Ex Sp 258
 - 2 Leadership Techniques for Fitness Programs—Ex Sp 259
 - 3 Management in the Sport Enterprise—Ex Sp 340
 - R Job Search Skills and Strategies—Ex Sp 401
 - 3 Health Promotion in the Community and Workplace—Ex Sp 440
 - 3 Principles of Fitness Assessment and Exercise Prescription—Ex Sp 458
 - 1 Internship in Exercise Leadership—Ex Sp 459
 - 2 Medical Aspects of Exercise—Ex Sp 462
 - 8-16 Internship in Sport and Exercise Science—Ex Sp 485A
 - 3-5 Statistics—select from Stat 101, 104, 227
 - 4 General Chemistry—Chem 163
 - 1 Laboratory in General Chemistry—Chem 163L
 - 4 Physics—select from Phys 106 or 111
 - 2 Lab in Human Anatomy and Physiology—Zool 156
 - 3 Intro to Human Nutrition—FS HN 167

11.5-21.5 Electives

Option 3. Athletic Training

The athletic training option prepares students for the NATA certification examination or for graduate work in athletic training. Admission to the athletic training option is based on available department resources and will be determined on the basis of grades in foundation courses and other performance factors. Details are available from the Health and Human Performance Advising Office.

- 48-54 Athletic Training Requirements**
- 3 Introduction to Human Nutrition—FS HN 167
 - 4 Physics—select from Phys 106 or 111
 - 2 Basic Athletic Training—Ex Sp 220
 - 1 Athletic Training Practicum—Ex Sp 221
 - 3 Evaluation of Athletic Injuries I—Ex Sp 224
 - 1 Athletic Training Practicum—Ex Sp 225
 - 3 Evaluation of Athletic Injuries II—Ex Sp 226
 - 1 Athletic Training Practicum—Ex Sp 227
 - 2 Therapeutic Modalities for Athletic Trainers—Ex Sp 323
 - 2 Physical Fitness and Conditioning—Ex Sp 258
 - 3 Rehabilitation of Athletic Injuries—Ex Sp 326
 - 1 Athletic Training Practicum—Ex Sp 327
 - 2 Organization and Administration of Athletic Training—Ex Sp 425

- R Job Search Skills and Strategies—Ex Sp 401
- 3 Legal Aspects of Sport—Ex Sp 445
- 3 Principles of Fitness Assessment and Exercise Prescription—Ex Sp 458
- 4 General Chemistry—Chem 163
- 1 Laboratory in General Chemistry—Chem 163L
- 3 Drug Education—H S 215
- 3 Human Diseases—H S 350
- 3-5 Statistics—select from Stat 101, 104, 227

10.5-16.5 Electives

Option 4. Sport Management

The sport management option prepares students for a variety of sport specialist and leadership positions in amateur and professional sport organizations, health and sport clubs, community recreation centers, resorts, voluntary agencies such as YM/YWCA's, industry, and other public and private agencies involving sports instruction, recreational sports activities, and sport/fitness management.

- 47-57 Sport Management Requirements**
- 3 Principles of Sport Management—Ex Sp 340
 - 3 Sport Marketing—Ex Sp 350
 - 3 Sport Facility and Event Management—Ex Sp 352
 - R Job Search Skills and Strategies—Ex Sp 401
 - 3 Sport Business and Finance—Ex Sp 435
 - 3 Legal Aspects of Sport—Ex Sp 445
 - 3-5 Statistics—select from: Stat 101, 104, 227
 - 3 Principles of Marketing—Mkt 340
 - 3 Organization and Theory—Mgmt 370
 - 3 Organizational Behavior—Mgmt 371
 - 3 Financial Accounting—Acct 284
 - 3 Principles of Public Relations—JI MC 220 or Principles of Advertising—JI MC 230
 - 3 Principles of Microeconomics—Econ 101
 - 3 Principles of Macroeconomics—Econ 102
 - 8-16 Internship in Sport and Exercise Science—Ex Sp 485C

9.5-19.5 Electives

Option 5. General Exercise and Sport Studies

The general exercise and sport studies option is planned for students who are interested in an interdisciplinary approach to the study of human movement. In this option, exercise and sport science is combined with a concentration in another area of study to support an individualized program, such as dance, sports psychology, sports information and promotion, or other sport related fields. This option also provides preprofessional training for students who are preparing for advanced study leading to careers in physical therapy, or other allied health programs.

- R Job Search Skills and Strategies—Ex Sp 401
- 6 Exercise and Sport Science Professional Courses**
- 3-5 Statistics—select from Stat 101, 104, 227
- 26 Meet the requirements of a specialization area in a related field (area and program must be approved by the Department of Health and Human Performance).

29.5-31.5 Electives

Curriculum in Industrial Technology

The industrial technology curriculum prepares students for professional positions in industry, business, or government that emphasize technical management. The Bachelor of Science degree program stresses computer application, technical management, production processing, and product quality. The curriculum has been designed to assist students to develop a comprehensive understanding of people, machines, tools, equipment, safety, processes, planning, and other industrial phenomena related to industrial productivity. Extensive laboratory experience has been incorporated into most courses. Problem solving and creativity are outcomes which assist graduates as they meet the technical, human, and regulatory needs of industry.

Students majoring in industrial technology select one of the three options: manufacturing, occupational safety, or training and development.

English Proficiency In order to meet graduation requirements, all students must earn an average of C (2.0) or better in all English courses taken, including Engl 104, Engl 105, and one of the following: Engl 309 or Engl 314.

U. S. Diversity and International Perspectives In order to meet graduation requirements, all students must complete 3 credits of course work in U.S. Diversity and 3 credits in International Perspectives. See department for approved lists of courses.

Total credits required: 121.5-126.5.

For additional information see *Index, Industrial Technology*.

Industrial Technology Major

- | | |
|-------------|---|
| Cr. | |
| 44.5 | General Education |
| 16 | Biology and physical sciences, mathematics
Chem 163, 163L, Math 142, 160, Phys 111 |
| 9 | Social sciences
Psych 101, Econ 101. Select 3 credits from African American Studies, anthropology, economics, International Perspectives studies, political sciences, psychology, sociology, or women's studies to meet the university's |

- U.S. diversity or internationalization requirement. (see departmental office for specific list of courses.)
- 6 Humanities
Select from art, foreign languages, history, literature, music, philosophy, or religion. Select 3 credits to meet the university's U.S. diversity or Internationalization Perspectives requirement. (see departmental office for specific list of courses.)
- 9.5 Communication skills
Engl 104, 105, Sp Cm 212, Lib 160
- 4 Health, safety, physical education, dance
I Tec 270, 1 credit in P E
- 10 **Technical core**
- 4 Introduction to Technical Graphics, Interpretation and CAD—I Tec 120
- 3 Introduction to Manufacturing Materials, Processing, and Systems—I Tec 130
- 3 Advanced Manufacturing, Materials and Processes—I Tec 231
- 22 **Professional**
- R Introduction to Industrial Technology—I Tec 110
- 3 Introduction to Training and Development—I Tec 202
- 3 Total Quality Improvement—I Tec 360
- 3 Handling of Hazardous Materials—I Tec 372
- 1 Seminar in Industrial Technology—I Tec 395
- 2 Supervised Industrial Internship/Cooperative Experience—I Tec 480 or I Tec 481
- 4 Principles of Statistics—Stat 101
- 3 Report and Proposal Writing—Engl 309 or Technical Communications—Engl 314
- 3 Professional Communication—ComSt 214

Students may select one of three options:
Manufacturing prepares students to plan and coordinate materials, machines, methods, and human resources in a manufacturing environment.

Occupational safety prepares students to develop, coordinate, and evaluate the safety issues relating to people, materials, equipment, and environments.

Training and development prepares students to analyze, design, develop, implement, and evaluate training programs in business and industry.

Options

- 47 **Manufacturing Option (123.5 Cr.)**
- 3 Electrical Fundamentals—I Tec 140
- 3 Computer Applications in Industrial Technology—I Tec 216
- 4 Advanced Technical Graphics, Interpretation, and CAD—I Tec 224
- 3 Analog Manufacturing Applications—I Tec 240
- 3 Automated Manufacturing Processes—I Tec 336
- 2 Digital Manufacturing Applications—I Tec 340
- 3 Facility Planning—I Tec 410
- 3 Computer Aided Manufacturing—I Tec 435
- 2 Electrical Outputs for Manufacturing—I Tec 440
- 3 Automated Systems—I Tec 446
- 9 Technical electives
Select from:
- 3 Integrated/Mechanical Fluid Systems—I Tec 244
- 3 Polymer and Composite Processing—I Tec 330
- 3 Statics and Strength of Materials—I Tec 423
- 3 Materials Testing and Processing—I Tec 433
- 3 Independent Study in Industrial Technology—I Tec 490
- 6 Related courses
- 3 Principles of Organization and Management—Mgmt 370
- 3 Financial Accounting—Acct 284
- 3 Electives

- 50 **Occupational Safety Option (126.5 Cr.)**
- 3 Electrical Fundamentals for Industrial Safety Personnel—I Tec 141
- 3 Introduction to Occupational Safety—I Tec 272
- 2 Construction Safety—I Tec 290
- 3 Hazardous Materials Handling—I Tec 293
- 3 Legal Aspects of Occupational Safety and Health—I Tec 294
- 3 Fire Protection and Prevention—I Tec 296
- 3 Accident Investigation and Response—I Tec 297
- 3 Industrial Hygiene: Chemical Hazards—I Tec 470
- 3 Industrial Hygiene: Physical Hazards—I Tec 471
- 2 Systems Safety Analysis—I Tec 472
- 2 Safety Research and Design—I Tec 475
- 20 **Related Courses**
- 4 Applied Ergonomics and Work Design—I E 271
- 4 General Physics—Phys 112
- 3 Elementary Organic Chemistry—Chem 231
- 1 Elementary Organic Chemistry Laboratory—Chem 232A
- 3 Basic Human Physiology and Anatomy—Zool 155
- 2 First Aid and Emergency Care—H S 105
- 3 Principles of Organization and Management—Mgmt 370 or Financial Accounting—Acct 284
- 46 **Training and Development Option (122.5 Cr.)**
- 3 Electrical Fundamentals—I Tec 140
- 3 Industrial Training Needs Assessment—I Tec 303
- 3 Facilitation of Workplace Learning—I Tec 402
- 3 HRD Program and Workplace Learner Evaluation—I Tec 405
- 3 Topics in Workplace Learning—I Tec 406
- 31 **Related Courses**
- 4 Computer Applications—Com S 103
- 3 Organizational Communications—ComSt 314
- 3 Motivation—Psych 314
- 3 Principles of Marketing—Mkt 340
- 3 Introduction to Instructional Technology—C I 201
- 3 Financial Accounting—Acct 284
- 3 Principles of Organization and Management—Mgmt 370
- 9 Electives*

*Electives must be approved by the department.

College of Engineering

James L. Melsa, Dean
David K. Holger, Associate Dean
Theodore H. Okiishi, Associate Dean
Loren W. Zachary, Assistant Dean

Departments of the College

Aerospace Engineering and Engineering Mechanics
Agricultural and Biosystems Engineering
Chemical Engineering
Civil and Construction Engineering
Electrical and Computer Engineering
Industrial and Manufacturing Systems Engineering
Materials Science and Engineering
Mechanical Engineering

Engineers occupy a uniquely important position in our modern civilization. They have the responsibility for taking the discoveries of basic science and translating them into processes, materials, products, structures, facilities, and services for society.

Objectives of Curricula in Engineering

Engineering education seeks to develop a capacity for objective analysis, synthesis, and design to obtain a practical solution. The engineering programs at Iowa State University are designed to develop the professional competence of a diverse student body and, by breadth of study, to prepare students to solve the technical problems of society while considering the ethical, social, and economic implications of their work.

Experiences contained within the programs are intended to develop in each student an ability to apply knowledge of mathematics and science to engineering problems; an ability to design and conduct engineering experiments, including analyzing and interpreting data from experiments; an ability to design a system, component, or process to meet desired needs; an ability to function on multi-disciplinary teams in the solution of engineering problems; an ability to identify, formulate, and solve engineering problems; an ability to communicate effectively; the broad education necessary to understand the impact of engineering solutions in a global and national context; a recognition of the need for and an ability to engage in life-long learning; a knowledge of contemporary issues; and, an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Registration as a professional engineer, which is granted by each individual state, is required for many types of positions. The professional curricula in engineering at Iowa State University are designed to prepare a graduate for subsequent registration in all states. Seniors in accredited curricula (accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology) of the College of Engineering are encouraged to take the Fundamentals of

Engineering Examination toward professional registration during their final academic year. Seniors in engineering curricula who have obtained at least 6 semester credits in surveying may take the Fundamentals Examination for professional registration as land surveyors.

Advanced work in engineering is offered in the post-graduate programs. See the Graduate College section of this catalog.

Organization of Curricula

All curricula in engineering are designed as four-year programs. They are structured in two phases: a basic program and a professional program. The basic program consists primarily of subjects fundamental and common to all branches of engineering and includes chemistry, physics, mathematics, engineering computations, and English. The professional phase of a curriculum includes intensive study in a particular branch of engineering, as well as a continuation of supporting work in mathematics, basic sciences, humanities, and social sciences.

Students must complete the requirements of the basic program before proceeding to a professional program.

Preparation for the Engineering Curricula

High school credits particularly important to students wishing to study engineering include 2 years of algebra, 1 year of geometry, and 1/2 year of trigonometry; 1 year each of chemistry and physics, and 4 years of English. See *Index* for specific admission requirements. Placement in mathematics, English, and chemistry will generally be based on high school preparation and test scores. Advanced placement is possible for exceptionally well-prepared students. Students who are not adequately prepared may be encouraged or required to take additional preparatory coursework and should expect to spend more than the customary time to complete the engineering program. Any coursework which is preparatory or remedial in nature cannot be used to satisfy credit requirements for graduation in any of the engineering curricula.

Basic Program for Professional Engineering Curricula

The first year program is much the same for all professional curricula in the College of Engineering. Each curriculum requires completion of the basic program as well as the curriculum designated requirements. The basic program is a set of courses common to all engineering curricula, while the curriculum designated requirements are courses required by individual curricula. The student who desires to receive the bachelor's degree in a minimum time will find it desirable to select a curriculum as soon as possible.

Entering undergraduates must demonstrate proficiency in trigonometry based on test scores, or by having transfer credits from a college trigonometry course, or by passing one of Math 141, 142 or 149 before enrolling in Math 166, Engr 160 or Engr 161.

The Department of English may recommend placement in one or more sections of Engl 101 because of unsatisfactory performance on the English placement test administered to students whose first language is not English.

Basic Program

Cr.	
8	Mathematics 165, 166
6	English 104, 105
4	Chemistry 167 or 177*
3	Engineering 160 or 161**
5	Physics 221
R	Engineering 101
0.5	Library 160
26.5	Total credits

Curriculum Designated Requirements

Aerospace Engineering—SSH elective (3 cr.), Aer E 170 (2 cr.)
Agricultural Engineering—Chem 167L (1 cr.) or 177L (1 cr.)*, A E 110 (1 cr.), Engr 170 (3 cr.)
Chemical Engineering—Chem 177*, 177L (1 cr.), 178 (3 cr.), 178L (1 cr.)
Civil Engineering—Chem 177*, Chem 177L (1 cr.), Chem 178 (3 cr.), Chem 178L (1 cr.), C E 102 (1 cr.), C E 170 (2 cr.), C E 111 (3 cr.), (Physics 221 scheduled in sophomore year.)
Computer Engineering—Com S 227 (3 cr.), 228 (3 cr.), Engr 161**, E E 166 (R cr.)
Construction Engineering—Con E 110 (R cr.), Psych 101 (3 cr.), Engr 170 (3 cr.)
Electrical Engineering—Engr 161**, Com S 227 (3 cr.), E E 166 (R cr.)
Engineering Operations—SSH elective (3 cr.)
Engineering Science—Chem 167L (1 cr.), SSH elective (3 cr.), E Sci 170 (2 cr.)
Industrial Engineering—I E 101 (R cr.), ComSt 214 (3 cr.), SSH elective (3 cr.), Engr 161**
Materials Engineering—Chem 177*, 177L (1 cr.), 178 (3 cr.), 178L (1 cr.), Engr 170 (3 cr.), (Physics 221 scheduled in sophomore year.)
Mechanical Engineering—Chem 167L (1 cr.), Engr 170 (3 cr.), M E 102 (R cr.)

The student's adviser may require or recommend courses in addition to those specified above if the preparation and progress of the student are such that additional courses are necessary or desirable.

*Students planning to enroll in A E (Biosystems Engineering Option), C E , Ch E, or Mat E will find Chem 177 to be a better preparation for Chem 178. However, Chem 167 is accepted as a substitute for 177 for

those students declaring one of these curricula after having completed 167. The Chem 155-165 sequence is an acceptable substitute for Chem 167.

**Students planning to enroll in E E, Cpr E, or I E will find Engr 161 to be a better preparation for future classes. However, credit hours for graduation will be given for either 160 or 161 without increasing a curriculum's minimum number of credits required for graduation.

Requirement for Entry into Professional Program

Students enrolled in the College of Engineering must satisfy both of the following requirements before enrolling in the professional courses (200-level and above) offered by departments in the Engineering College:

1. Completion of the basic program with a grade point average of 2.00 or better in the basic program courses.
2. A cumulative grade point average of 2.00 or better for all courses taken at Iowa State University.

The following are the only exceptions to this rule:

- a. Students who have completed all of their coursework while enrolled in the College of Engineering, but have not met the two basic program requirements, may enroll for not more than one semester in 200-level or above courses offered by departments in the College of Engineering. This exception may be extended to two semesters for students whose curriculum requires Chem 178 and 178L (i.e. Ch E, C E, and Mat E).
- b. Students transferring to the College of Engineering from another college or university, or from a program outside this college, who have not met the two basic program requirements may enroll for not more than two semesters in 200-level or above courses offered by departments in the College of Engineering.
- c. Iowa State students not pursuing an engineering degree may generally take engineering courses without restrictions provided they meet the prerequisites and space is available.
- d. Only the first two semesters of 200-level and above engineering courses, taken at ISU while a student is not enrolled in the College of Engineering, can be applied toward an engineering degree.

Requirement for Graduation

In order to graduate in a professional engineering curriculum, a student must have a minimum GPA of 2.00 in a department-designated group of 200-level and above courses known as the Core. These courses will total no fewer than 24 nor more than 48 semester credits.

Engineering Minors

The College of Engineering offers an undergraduate minor in Nondestructive Evaluation. It is open only to engineering students who have met the basic program requirements and are not on temporary enrollment. The NDE minor consists of one common core course, at least two NDE specific technique courses and at least two supporting courses. Both technique

and supporting courses must be selected from lists approved by the advisory committee. A student's minor program in Nondestructive Evaluation must include at least nine credits which are beyond the total used to meet curriculum requirements. The minor is supervised by an interdisciplinary faculty committee. Interested students may contact the AEEM department to obtain more specific guidelines and requirements.

Undergraduate Majors and Minors Outside the College of Engineering

In addition to the engineering degree program, students may earn majors or minors in other colleges of the university. A major or minor program must meet all requirements of the offering department or program and its college and contain credits beyond the requirements for a B.S. degree in engineering. A minimum of 15 additional credits is required for each major area of study and an additional 9 credits for each minor.

Advising System

The purpose of the advising system in the College of Engineering is to work constructively with students in developing their individual academic programs and to maintain close contact with students during their college careers.

The college offers an orientation program during the spring and summer for students planning to enter in the fall and during the fall for students planning to enter in the spring. All entering students are encouraged to attend an orientation session. Tests given during the orientation program help determine the student's level of achievement and enable the adviser to prepare an appropriate program for the student.

Special Programs

Engineering College students may participate in the following undergraduate programs. These programs are integrated into the professional engineering curricula and often require additional work. Each individual program is developed by the student and her/his engineering adviser.

a. Cooperative Education Program—The College of Engineering offers, through its curricula, an accredited cooperative education program. Enrollment in the program allows students to gain practical experience in their career field while attending college. In general, students enrolled in the co-op program will require an additional year to complete curriculum requirements.

These programs are arranged so that the student alternates academic work with employment periods. The student has the opportunity to assess career paths within her/his chosen curriculum and the employer evaluates the student's potential as a future full-time employee. Both domestic and international co-op programs are available.

Cooperative education students pay no fees to the university during their work periods and do not receive credit hours for their work experience. Students register for a non-credit cooperative education course (298, 398, or 498) for each work period and are considered full time students while enrolled in these courses. For additional information contact your academic adviser and the Office of Engineering Career Services.

b. Internship Program. Internships are a mechanism by which a student may work full-time for one semester while maintaining her/his status as a full-time student.

Internship students pay no fees to the university during their work periods and do not receive credit hours for their work experience. Students may register for the internship course (397) for a fall or spring semester work period and are considered to be full time students. For additional information contact your academic adviser and the Office of Engineering Career Services.

c. Honors Program. The College of Engineering participates in the University Honors Program (see *Index*). In summary, the Honors Program is designed for students with above average ability who wish to individualize their programs of study. For further details consult the chair of the Engineering College Honors Program Committee or your departmental Honors Program adviser.

Curriculum in Aerospace Engineering

Administered by the Department of Aerospace Engineering and Engineering Mechanics.

Leading to the degree bachelor of science.

Total credits required: 128.5. See also *Basic Program and Cooperative Programs*.

Professional Program

Sophomore Year

Cr.	Fall
4	Calculus III—Math 265
5	Introduction to Classical Physics II—Phys 222
3	Statics of Engineering—E M 274*
3	Introduction to Aerospace Engineering—Aer E 201*
2	Instrumentation Laboratory I—Aer E 202*
R	Aerospace Seminar—Aer E 291
17	
Cr.	Spring
4	Elementary Differential Equations and Laplace Transforms—Math 267
3	Mechanics of Materials—E M 324*
3	Dynamics—E M 345*
3	Aerodynamics I—Aer E 243*

- 0.5 Aerodynamics Laboratory I—Aer E 243L*
- 3 SSH elective¹
- R Aerospace Seminar—Aer E 292
- 16.5

Junior Year

- Cr. Fall**
- 4 Thermodynamics and Gas Dynamics for Aerospace Engineers—Aer E 311*
- 0.5 Gas Dynamics Laboratory—Aer E 311L*
- 3 Materials for Aerospace Applications—Mat E 273*
- 5 Flight Structures I—Aer E 322*
- 5 Flight Vehicle Performance, Stability and Control—Aer E 356*
- R Flight Experience—Aer E 301
- R Aerospace Seminar—Aer E 391
- 17.5
- Cr. Spring**
- 3 Aerodynamic Theory II—Aer E 343*
- 1 Advanced Aerodynamics and Propulsion Laboratory—Aer E 343L*
- 3 Flight Control Systems I—Aer E 331*
- 3 Aerospace Vehicle Propulsion I—Aer E 312*
- 3 Astrodynamics I—Aer E 351*
- 3 Computational Techniques for Aerospace Design—Aer E 361*
- R Aerospace Seminar—Aer E 392
- 16

Senior Year

- Cr. Fall**
- 3 Modern Design Methodology with Aerospace Applications—Aer E 461*
- 1 Instrumentation Laboratory II—Aer E 402*
- 1 Senior Project—Aer E 494*
- 3 Technical elective²
- 3 Technical elective²
- 3 SSH elective¹
- R Aerospace Seminar—Aer E 491
- 14
- Cr. Spring**
- 3 Design of Aerospace Systems—Aer E 462*
- 1 Senior Project—Aer E 495*
- 3 Technical elective²
- 3 Technical elective²
- 3 SSH elective¹
- 3 SSH elective¹
- R Aerospace Symposium—Aer E 493
- R Aerospace Seminar—Aer E 492
- 16

English Proficiency

The department requires a grade of C (2.0) or better in Engl 104 and 105 to be eligible for English Proficiency Certification. Students satisfying this requirement who are not cited for deficiencies in reports, laboratory reports, or other writings required in other courses, are certified during the semester prior to their

semester of graduation. Students not satisfying these requirements are referred to the department's Academic Standards Committee for corrective action.

¹The social sciences and humanities (SSH) electives are to be selected from the department-approved list of courses, subject to department guidelines. Not to be taken under the P-NP policy.

²Twelve elective credits scheduled to be taken at the senior year are of three types: (1) Aerospace Program Technical Electives, 3 credits; (2) Technical Electives, 3 credits; and (3) Career Electives, 6 credits. Aerospace Program Technical Electives and the Technical Electives must be chosen from department-approved lists for each type. All electives must be chosen following published department guidelines. These courses are not to be taken under the P-NP policy.

*Core professional curriculum. A student must have a minimum grade-point average of 2.00 in this group of courses in order to graduate.

Curriculum in Agricultural Engineering

Administered by the Department of Agricultural and Biosystems Engineering.

With options in agricultural power and machinery, biosystems engineering, environmental and natural resources engineering, food and process engineering, structures and environmental systems engineering. Administered jointly by the College of Agriculture and the College of Engineering. Leading to the degree bachelor of science. **Total credits required: 127.5.** See also *Basic Program and Cooperative Programs.*

Sophomore Year

- Cr. Fall**
- 3 Agricultural Engineering Fundamentals—A E 215*

- 5 Introduction to Classical Physics II—Phys 222*
- 3 Statics of Engineering—E M 274*
- 4 Option Requirement²
- 1 Engineering Applications of AutoCAD—A E 271*
- 16

- Cr. Spring**
- 3 Agricultural Engineering Fundamentals II—A E 216*
- 3 Mechanics of Materials—E M 324*
- 1 Mechanics of Materials Laboratory—E M 327*
- 3 Principles of Microeconomics—Econ 101 or Principles of Macroeconomics—Econ 102
- 3 Elementary Differential Equations—Math 266*
- 3 Engineering Statistics—Stat 305*
- 16

Junior Year

- Cr. Fall**
- 3 Thermodynamics—M E 330*
- 13 Option requirement²
- 16
- Cr. Spring**
- 10 Option requirements²
- 3 SSH elective¹
- 3 Communications requirement³
- 16

Senior Year

- Cr. Fall**
- R Senior Seminar—A E 401
- 1 Agricultural Engineering Design I—A E 445*
- 6 SSH elective¹
- 9 Option requirements²
- 16
- Cr. Spring**
- 3 Agricultural Engineering Design II—A E 446*
- 3 SSH elective¹
- 10 Option requirements²
- 16



English Proficiency

The department requires a grade of C or better in Engl 104 and 105 (or 105H) and a grade of C or better in the course taken to meet the communication requirement.

¹Social sciences and humanities (SSH) electives are to be chosen from the department-approved list. The courses chosen must meet departmental requirements.

²After the freshman year, each student elects one of the options and takes courses listed for the selected option. The elective courses must be selected from department-approved list.

³One course must be taken from Sp Cm 212, Engl 309, Engl 314.

*Core professional curriculum. A student must have a minimum grade-point average of 2.00 in this group of courses in order to graduate.

Options

Agricultural Power and Machinery—A E 303, 342, 413, 447; select two courses from 363, 372, 409, 422, 478; Agron 154; E E 441; E M 345, 378; Math 268; Mat E 272; M E 324, 325; 3 credits in biological and natural resource science from department-approved list; 4 credits of technical electives to be selected with adviser.

Structures and Environmental Systems Engineering—A E 363, 372, 404, 473, 478, and 3 credits from A E 342, 422, 451, 465, 469; E M 378; 6 credits biological and natural sciences from department-approved list; and 19 credits from department-approved electives list.

Environmental and Natural Resources Engineering—A E 303, 372, 409, 422; Agron 154, Biol 202; Chem 231, 231L; C E 326, 360, 372; E M 378; Micro 201 and 9 credits from department-approved electives list.

Food and Process Engineering—A E 363, 409, 451, 465, 469; Biol 202; Chem 231, 231L, Ch E 356 or E M 378; A E 372 or Ch E 357; FS HN 311, 420, Micro 201; and 10 credits from department-approved electives list.

Biosystems Engineering—A E 363, 409, 451, 465, 469; BBMB 301; Biol 202; Ch E 356, 357, 415; Chem 178, 231, 231L; Micro 302; and 6 credits from department-approved electives list.

Curriculum in Chemical Engineering

Leading to the degree bachelor of science.

Total credits required: 124.5. See also *Basic Program and Cooperative Programs.*

Professional Program

Sophomore Year

Cr.	Fall
3	Material and Energy Balances—Ch E 210*
4	Calculus III—Math 265
5	Introduction to Classical Physics II—Phys 222
3	Organic Chemistry—Chem 331
15	

Cr.	Spring
3	Transport Phenomena I—Ch E 356*
4	Elementary Differential Equations and Laplace Transforms—Math 267
3	Organic Chemistry—Chem 332
3	Physical Chemistry—Chem 321
3	SSH elective ¹
16	

Junior Year

Cr.	Fall
3	Transport Phenomena II—Ch E 357*
3	Chemical Engineering Thermodynamics—Ch E 381*
3	Chemistry elective ²
3	SSH elective ¹
3	Communication elective ³
15	

Cr.	Spring
3	Separations—Ch E 358*
2	Chemical Engineering Laboratory I—Ch E 325
3	Chemical Reaction Engineering—Ch E 382
3	Chemistry elective ²
3	Statistics elective ⁴
3	SSH elective ¹
17	

Senior Year

Cr.	Fall
3	Process Control—Ch E 421*
3	Engineering elective ⁵
3	Professional elective ⁶
3	SSH electives ¹
3	SSH electives ¹
15	
Cr.	Spring
4	Process and Plant Design—Ch E 430*
3	Professional elective ⁶
3	SSH elective ¹
3	Chemical Engineering elective ⁷
2	Chemical Engineering Laboratory II—Ch E 426*
15	

English Proficiency

The department requires satisfactory completion of Engl 104, 105 (or 105H), and the Communications elective.

¹Selected from list of department-approved social sciences and humanities (SSH) courses.

²Selected from department-approved list.

³Selected from department-approved list.

⁴Selected from department-approved list.

⁵Selected from department-approved list.

⁶Selected from department-approved list.

⁷Selected from department-approved list.

*Core professional curriculum. A student must have a minimum grade-point average of 2.00 in this group of courses in order to graduate.

Curriculum in Civil Engineering

Administered by the Department of Civil and Construction Engineering

Leading to the degree bachelor of science.

Total credits required: 127.5 general (G) emphasis; 134.5 emphasis (E) for specialization. An emphasis in Environmental Engineering is offered. For any area of emphasis, see the department office Curriculum Student Guide. Also see *Basic Program and Cooperative Programs.*

For those interested in construction engineering, a curriculum is provided which leads to the degree bachelor of science in construction engineering. For particulars, see *Curriculum in Construction Engineering.*

Sophomore Year

Cr.	Fall
3	Differential Equations—Math 266
5	Introduction to Classical Physics I—Phys 221
5	Statics and Dynamics—E M 307* (G)
3	Statics—E M 274* (E)
R	Pre-professional Experience in Civil Engineering I—C E 201
3	Statistics (from approved list)
3	Engineering Topics ¹ (E)
16 G; 17 E	

Cr.	Spring
3	Mechanics of Materials—E M 324*
1	Mechanics of Materials Laboratory—E M 327
3	Geology for Engineers—Geol 201
3	Numerical Analysis (from approved list)
2	Analysis for Engineering Economy—I E 304
3	Fundamentals of Public Speaking—Sp Cm 212
R	Pre-professional Experience in Civil Engineering II—C E 202
3	Engineering Topics ¹ (E)
15 (G); 18 (E)	

Junior Year

Cr.	Fall
3	Principles of Environmental Engineering—C E 326*
3	Structural Analysis I—C E 332*
3	Mechanics of Fluids—E M 378*
3	Soil Engineering—C E 360*
3	Professional Issues in Civil Engineering—C E 301*
15 G; 15 E	
Cr.	Spring
3	Structural Steel Design I—C E 333 (G)
3	Technical Communication—Engl 314
R	Professional Progress Assessment—C E 302
3	Design of Concretes and Pavement Structures—C E 382
4	Engineering Hydrology and Hydraulics—C E 372*
3	Engineering Science or Life Science Elective ¹
3	Engineering Topics ¹ (E)
16 G; 19 E	

Senior Year

Cr.	Fall
3	Reinforced Concrete Design I—C E 334
1	Professional Technical Outcomes Assessment—C E 401
4	Highway Design—C E 453
6	Social sciences or humanities electives ¹
3	Engineering Topics electives ¹
17 G; 17 E	
Cr.	Spring
3	Engineering Design—C E 486
1	Professional Continuing Development—C E 402
9	Social sciences or humanities electives ¹
3	Engineering Topics electives ¹
16 G; 16 E	

English Proficiency

Students receiving a grade of C or better in Engl 104 and 105 meet the proficiency requirement of the department. Students not meeting this condition must fulfill an advanced composition requirement specified in the Curriculum Student Guide.

¹A minimum of 15 credits of social science or humanities electives shall conform to focal areas as specified in the Curriculum Student Guide, or as approved by the academic adviser and the Civil Engineering Curriculum Committee to meet an approved educational objective of the student's undergraduate program. Engineering topics electives for an emphasis within Civil Engineering shall meet the requirements adopted by the faculty and listed in the Curriculum Student Guide. For an emphasis in Environmental Engineering, the engineering topics shall include: Biol 109, Chem 232, C E 427, 428, and 429. Engineering science or life science elective must be selected from E E 441, M E. 330, Mat E 272 or Micro 201. Environmental Engineering emphasis must take Micro 201. Students appointed to advanced ROTC may substitute 3 credits of

advanced ROTC credits for 3 credits of engineering topics in the general emphasis curriculum. Elective courses and procedures to meet the Diversity and International Perspective requirements are given in the Curriculum Student Guide.

*Core professional curriculum. A student must have a minimum grade-point average of 2.00 in this group of courses in order to graduate.

Curriculum in Computer Engineering

Administered by the Department of Electrical and Computer Engineering.

Leading to the degree bachelor of science.

Total credits required: 122.5. See also *Basic Program and Cooperative Programs.*

Sophomore Year

Cr.	First Semester
4	Introduction to Digital Techniques and Circuits—Cpr E 210*
4	Electric Circuits—E E201*
4	Elementary Differential Equations and Laplace Transforms—Math 267
5	Introduction to Classical Physics II—Phys 222
17	
Cr.	Second Semester
4	Digital Systems Design—Cpr E 211*
3	Theoretical Foundations of Computer Engineering—Cpr E 310*
4	Calculus III—Math 265
4	Electronic Devices and Circuits—E E 333*
15	

Junior Year

Cr.	First Semester
4	Computer Systems Design and Interfacing—Cpr E 301*
3	Computer Systems Organization and Architecture—Cpr E 305*
3	Data Structures and Algorithm Analysis—Com S 311*
1	The Engineering Professional—E E 391
3	Technical Communication—Engl 314*
14	
Cr.	Second Semester
3	Software Engineering—Com S 309*
4	Software Systems Integration—Cpr E 308*
3	Electromagnetics Applications in Computer Systems—E E 213*
6	General education electives ¹
16	

Senior Year

Cr.	First Semester
2	Digital Systems Design I—Cpr E 491
3	Computer Engineering elective ²
3	Mathematics elective ³
6	General education electives ¹
R	Portfolio Assessment—E E 493 ⁴
14	
Cr.	Second Semester
2	Digital Systems Design II—Cpr E 492
3	Computer Science elective ²
6	Technical elective ²
3	General education electives ¹
14	

English Proficiency

The department requires a grade of C or better in Engl 104, 105 (or 105H), and 314.

¹General Education Electives-Students must propose and have approved by their faculty adviser a general education program of 15 credits that meets the university diversity and international perspectives requirements and an objective developed by the student. Courses chosen must not be remedial courses in the university, six (6) credits must be chosen at the 300 level or higher, and courses in engineering, physical and mathematical sciences must not be included.

²Computer Engineering, Computer Science, and general technical electives must be chosen to satisfy departmental requirements concerning content, distribution, and level. All technical electives must be chosen from lists approved by the department. Details are available in the E CPE Undergraduate Student Services Center or on the Web. Pass/not pass credit not accepted. Three credits of Computer Engineering, three credits of Computer Science, and three credits of general technical electives are required. Credit in 490 can not be used to fulfill these elective credits.

³The student must choose one of the following math courses (pass/not pass credit not accepted): Math 273, 307, 471 or 481. Credit in 490 can not be used to fulfill this elective requirement.

⁴Outcomes Assessment- Students are required to prepare and to maintain a portfolio of their technical and non-technical skills. This portfolio is evaluated for student preparation during the student's curriculum planning process. Results of the evaluation are used to advise students of core strengths and weaknesses. Prerequisite material exams are given at key points in the curriculum. These exams are to assist student evaluation of progress made during the academic experience as the material covered in several courses are the foundation of more advanced courses. The results of these assessments are also used to evaluate the curriculum and to implement improvements.

*Core professional curriculum. A student must have a minimum grade-point average of 2.00 in this group of courses in order to graduate.

Curriculum in Construction Engineering

Administered by the Department of Civil and Construction Engineering.

Leading to the degree bachelor of science. **Total credits required: 122.5 Building emphasis; 123.5 Heavy emphasis; 124.5 or 126.5 Mechanical Electrical emphasis.** See also *Basic Program and Cooperative Programs.*

Sophomore Year

Cr.	Fall
3	Fundamentals of Surveying—C E 211
4	Contractor Organization and Management of Construction—Con E 221
4	Calculus III—Math 265
5	Introduction to Classical Physics II—Phys 222
16	
Cr.	Spring
3	Economics elective ¹
3	Statics of Engineering—E M 274*
3	Construction Materials and Methods—Con E 241
3	Elementary Differential Equations—Math 266 (B, H) or
4	Elementary Differential Equations with Laplace—Math 267 (M/E)
3	Financial Accounting—Acct 284
15	B, H; 16 M/E

Junior Year

Cr.	Fall
2	Construction Contract Documents—Con E 245
3	Mechanics of Materials—E M 324*
4	Engineering Thermodynamics I—M E 331* (M/E)
3	Engineering Law—Con E 380 (B,H)
3	Construction Equipment and Heavy Construction Methods—Con E 322* (B, H)
4	Electric Circuits—E E 201 (M/E)
3	Social Science & Humanities Elective 2 (B, H)
3	Mechanics of Fluids—E M 378
17	B, H; 16 M/E
Cr.	Spring
3	Structural Analysis I—C E 332*
3	Circuits and Systems—E E 202 (M/E)
3	Principles of Environmental Engineering—C E 326 (H)
3	Concrete and Steel Construction—Con E 340 (B, H)*
4	Mechanical/Electrical Systems for Buildings—Con E 351 (B, M/E)
3	Soil Engineering—C E360* (B, H)
2	Engineering Science elective ¹ (B, H)
1	Mechanics of Materials Lab—E M 327 (B, H)

3	Engineering Law—Con E 380* (M/E)
3	Business Communication elective ^{1, 3} (M/E)
16	B, M/E; 15 H

Senior Year

Cr.	Fall
3	Structural Steel Design I—C E 333 (B,H)
1	Professional Development—Con E 410
3	Construction Estimating—Con E 421*
2	Construction Planning, Scheduling, and Control—Con E 441
3	Heat Transfer—M E 436* (M/E)
2 or 3	Engineering Design Sequence (M/E) ¹
3	Design of Concretes and Pavement Structures—C E 382 (H)
1	Design of Portland Cement Concrete—C E 383 (B)
3	SSH elective ²
15	H, M; 14 E; 13 B
Cr.	Spring
3	Reinforced Concrete Design I—C E 334 (B,H)
4	Construction Engineering Design—Con E 461
2	Introduction to Electric Machinery—E E 448 (M/E)
2 or 3	Engineering design (M/E)
3	SSH elective ²
3	Business Communications elective (B, H)
3	SSH elective ² (M/E)
13	B, H; 14 E; 15 M

English Proficiency

All English courses taken, including those in the Basic Program, require a grade of C or better. A C– grade or less requires additional composition coursework.

B - Building construction emphasis.

H - Heavy construction emphasis.

M/E - Mechanical/Electrical construction emphasis.

Undesignated courses are for all emphases.

¹ Chosen from curriculum-approved lists. All electives must be taken for a grade. Pass-Not Pass grades are not acceptable.

² Social sciences and humanities (SSH) electives chosen from curriculum-approved list. One of these must have a prerequisite of Psych 101 or a previously taken social sciences and humanities elective.

³ All English courses taken, including those in the basic program, require a C or better. C- or less requires additional composition course work. All electives must be taken for a grade. Pass/not pass credits are not acceptable.

*Core professional curriculum. A student must have a minimum grade-point average of 2.00 in this group of courses in order to graduate.

Curriculum in Electrical Engineering

Administered by the Department of Electrical and Computer Engineering.

Leading to the degree bachelor of science. **Total credits required: 124.5.** See also *Basic Program and Cooperative Programs.*

Sophomore Year

Cr.	First Semester
4	Electric Circuits—E E 201*
4	Introduction to Digital Techniques and Circuits—Cpr E 210*
4	Elementary Differential Equations and Laplace Transforms—Math 267
5	Introduction to Classical Physics II—Phys 222
17	
Cr.	Second Semester
3	Circuits and Systems—E E 202*
3	Introduction to Modern Power Systems—E E 251*
4	Digital Systems Design—Cpr E 211*
4	Calculus III—Math 265
3	Introduction to Scientific Computation—Math 273
17	

Junior Year

Cr.	First Semester
4	Electronic Devices and Circuits—E E 333*
3	Introduction to Electromagnetic Fields—E E 312*
3	Signals and Systems—E E 321*
3	General education elective ¹
1	The Engineering Professional—E E 391
14	
Cr.	Second Semester
6	E E Core electives* ⁴
3	Technical Communication—Engl 314
6	General education electives ¹
15	

Senior Year

Cr.	First Semester
3	Software Engineering for Embedded Systems—Cpr E 320*
2	Analysis for Engineering Economy—I E 304
7	Technical electives ²
2	Electrical Systems Design I—E E 491
3	General education elective ¹
R	Portfolio Assessment—E E 493
17	

Cr.	Second Semester
7	Technical electives ²
2	Electrical Systems Design II—E E 492
3	Engineering Science elective ³
3	General education elective ¹
15	

English Proficiency

The department requires a grade of C or better in Engl 104, 105 (or 105H), and 314.

¹General Education Electives-Students must propose and have approved by their faculty adviser a general education program of 15 credits that meets the university diversity and international perspectives requirements and an objective developed by the student. Courses chosen must not be remedial courses in the university, six (6) credits must be chosen at the 300 level or higher, and courses in engineering, physical and mathematical sciences must not be included.

²Technical electives are of two types: (1) courses in computer engineering and electrical engineering, and (2) other courses in engineering and science. All technical electives must be chosen from lists approved by the department. Technical electives must be chosen to satisfy departmental requirements concerning content and distribution, level, and the engineering science and engineering design requirements. Details are available in the E CPE departmental Undergraduate Student Services Center and on the Web. Pass/not pass credit not accepted.

³Engineering science elective must be chosen from a list approved by the department; pass/not pass credit not accepted. This elective must be from another engineering department.

⁴Students must select two of the following 4 courses: Electromagnetic Fields and Waves—E E 313, Communications and Digital Signal Processing—E E 324, Electronic Materials for Devices with Applications—E E 332, Intermediate Engineering Mathematics—Math 395.

⁵Outcomes Assessment- Students are required to prepare and to maintain a portfolio of their technical and non-technical skills. This portfolio is evaluated for student preparation during the student's curriculum planning process. Results of the evaluation are used to advise students of core strengths and weaknesses. Prerequisite material exams are given at key points in the curriculum. These exams are to assist student evaluation of progress made during the academic experience as the material covered in several courses are the foundation of more advanced courses. The results of these assessments are also used to evaluate the curriculum and to implement improvements.

*Core professional curriculum. A student must have a minimum grade-point average of 2.00 in this group of courses in order to graduate.

Curriculum in Engineering Operations

Administered by a supervisory committee appointed by the dean of the College of Engineering.

Leading to the degree bachelor of science.

Total credits required: 124.5. Additional credits required for some emphases. See also *Basic Program and Cooperative Program*.

Program Requirements

Cr.	Basic Program
26.5	See Engineering Basic Program

Math/Basic Sciences

7	Math 265, 266
5	Phys 222
4 (3)	Select one: Stat 105, 231, 305, 333
16 (15)	Total

Engineering Operations Core

A student must have a minimum grade point average of 2.00 in this group of courses in order to graduate.

3	E M 274
4	E E 441
6	Select two: E M 324, 345, M E 330
18	Select 200-level and above engineering courses to support program objectives
31	Total

SSH Program

18	Select from approved list. Must include at least one course each from economics and psychology. Pass/not pass credit is not accepted.
18	Total

Supporting

3	Acct 284 or I E 305 or M I S 330
3	Con E 380 or Acct 215
3	Sp Cm 212
3	Engl 314 or 302
9 (10)	Select courses to strengthen program objectives or to serve as prerequisites for courses in other groups.
22 (23)	Total

Professional

12	Select 300-level and above courses to support professional objectives.
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English Proficiency

Engineering operations students (except engineering journalism students) must earn a grade of C (not C-) or higher in each of Sp Cm 212 and Engl 302 or 314. Students in the engineering journalism specialization must satisfy the requirement stated in the section, Engineering Journalism.

Emphasis in Engineering Journalism (133.5 credits)

A program in engineering journalism has been designed in the engineering operations curriculum for students who desire a knowledge of the fundamentals of engineering, science, communications, and human behavior, and who do not wish to pursue the more specialized engineering curricula. Graduates of this program should find interesting opportunities in a number of administrative areas in industry such as technical information, industrial communications, public relations, engineering sales, procurement, and production.

National journalism accreditation standards require a minimum of 90 semester credit hours in courses outside journalism and mass communication, with no fewer than 65 semester credits in the liberal arts and sciences.

Additional information concerning the journalism and mass communication courses and requirements may be obtained from the Advising office in the Greenlee School of Journalism and Communication. Required courses in the engineering journalism program include all the required courses in the engineering operations curriculum except as noted below.

The following number of credits in journalism must be included for the engineering journalism program:

Cr.

Pre-major requirements

3	Mass Media and Society—JI MC 101
R	Orientation to Journalism and Mass Communication—JI MC 110
3	Reporting and Writing for the Mass Media—JI MC 201

Major requirements (26-28 credits)

3	Intermediate Reporting and Writing for the Mass Media—JI MC 202 or Reporting and Writing for the Electronic Media—JI MC 206
3	Law of Communication—JI MC 460
3	Professional Media Internship—JI MC 499
11-12	300-level courses, at least one of which must be JI MC 306, 310, 321, 340, 342/342L/343L, 344, 346, 347, or 349
6	Additional 400-level courses, at least one of which must be JI MC 401, 406, 453, 454, 461, 462, 464, 474, 476, or 477
1	Senior Seminar only for students in Public Relations emphasis (JI MC 492), Print emphasis (JI MC 494) and Electronic Media Studies (JI MC 495)
32-34	Total

A 400-level journalism course may be substituted for Con E 380 and a 300-level course for Engl 314. Two courses selected from 401, 461, 462, 464, 474, and 476, 477 may be taken as social sciences and humanities electives, and four other 300- and 400-level courses as supporting electives.

English proficiency requirement: The student must either have achieved a score of 26 or higher on the ACT-English examination or passed the Greenlee School of Journalism and Communication's English usage test. Also, to meet the University's English Proficiency requirement, the student must earn a grade of C or better in Engl 104, 105 (or 105H), and a grade of C+ or better in JI MC 201 and 202 or 206.

Curriculum in Engineering Science

Administered by the Department of Aerospace Engineering and Engineering Mechanics.

Leading to the degree bachelor of science.
Total credits required: 125.5. See also *Basic Program and Cooperative Programs*.

Sophomore Year

Cr.	Fall
4	Calculus III—Math 265*
5	Introduction to Classical Physics II—Phys 222
3	Statics of Engineering—E M 274*
5	Introduction to Materials Science and Engineering—Mat E 211*
17	

Cr.	Spring
4	Elementary Differential Equations and Laplace Transforms—Math 267*
3	Mechanics of Materials—E M 324*
1	Mechanics of Materials Laboratory—E M 327
4	Probability and Statistical Inference for Engineers—Stat 231*
3	SSH electives ³
15	

Junior Year

Cr.	Fall
3	Communications Skills Elective ²
3	Dynamics—E M 345*
3	Computational Methods Requirement ⁶
3	Mechanics of Fluids—E M 378*
3	Depth/technical elective ^{1,4}
15	

Cr.	Spring
3	Experimental Methods in Engineering Science and Mechanics—E Sci 382
3	Depth/technical elective ^{1,4}
3	SSH elective ³
3	Engineering Thermodynamics I—M E 231*
2	Introduction to Circuits and Instruments—E E 442*
2	Introduction to AC Circuits and Motors—E E 448*
16	

Senior Year

Cr.	Fall
6	Depth/technical elective ^{1,4}
3	Mathematics Elective ¹
2	Senior Engineering Science Design Project I—E Sci 481 ⁵
3	SSH elective ³
R	Aerospace Seminar Aer E 491
14	

Cr.	Spring
9	Depth/technical elective ^{1,4}
3	SSH elective ³
4	Senior Engineering Science Design Project II—E Sci 482 ⁵
16	

English Proficiency

The department requires a grade of C (2.0) or better in Engl 104 and 105 to be eligible for English Proficiency Certification. Students satisfying this requirement who are not cited for deficiencies in reports, laboratory reports, or other writings required in other courses are certified during the semester prior to their semester of graduation. Students not satisfying these requirements are referred to the department's Academic Standards Committee for corrective action.

¹See department lists for approved mathematics electives, physical science electives, and technical electives.

²Any of the following courses are acceptable for satisfying the communications skills elective: Engl 220, 302, 309, 314, 415; Sp Cm 212.

³These electives are to be chosen from the department-approved list of social sciences and humanities (SSH) courses. At least one sequence consisting of two or three courses is required as part of the 15 credits of social sciences and humanities electives.

⁴Each student must develop an area of specialization in consultation with an academic advisor. This will be accomplished by taking two elective courses in the selected area of specialization. See department list for suggested lists of courses.

⁵Design courses in Aerospace Engineering, Computer Engineering, Electrical Engineering, Industrial Engineering, or Mechanical Engineering may be appropriate for some students based on the area of emphasis selected by the student. Appropriate substitutions may be made with the advice and approval of the student's advisor.

⁶Any of the following courses are acceptable for satisfying the computational methods requirement: Aer E 361; Math 273, 471, 481.

*Core professional curriculum. A student must have a minimum grade-point average of 2.00 in this group of courses in order to graduate.

Curriculum in Industrial Engineering

Administered by the Department of Industrial and Manufacturing Systems Engineering.

Leading to the degree bachelor of science.
Total credits required: 123.5. See also *Basic Program and Cooperative Programs*.

Sophomore Year

Cr.	Fall
4	Calculus III—Math 265
3	Introduction to Manufacturing Processes and Specifications—I E 248*
3	Materials Science and Engineering—Mat E 271
5	Introduction to Classical Physics II—Phys 222
15	

Cr.	Spring
4	Applied Ergonomics and Work Design—I E 271*
3	Elementary Differential Equations—Math 266
3	SSH elective ²
4	Probability and Statistical Inference for Engineers—Stat 231
14	

Junior Year

Cr.	Fall
3	Quality Control—I E 361*
3	Optimization—I E 312*
4	Introduction to Circuits, Instruments, & Electronics—E E 441*
3	Solidification Processes—I E 348*
3	SSH elective ²
16	

Cr.	Spring
3	Stochastic Analysis—I E 313*
4	Fundamentals of Mechanics—E M 301
3	Engineering Economic Analysis—I E 305*
3	Material Handling and Automation—I E 443*
3	Management elective ¹
16	

Senior Year

Cr.	Fall
3	Material and Project Control—I E 341*
3	Manufacturing Systems Modeling—I E 419*
3	Technical Communication—Engl 314
3	Manufacturing Systems Engineering—I E 448*
3	Focus elective ³
15	

Cr.	Spring
3	Thermodynamics—M E 330
3	Focus elective ³
3	Management elective ¹
3	SSH electives ²
3	Industrial Engineering Design—I E 441*
15	

English Proficiency

The department requires a C grade (2.0) or better in Engl 104 and 105.

*Core professional curriculum. A student must have a minimum grade-point average of 2.00 in this group of courses in order to graduate.

¹These electives are to be chosen from department-authorized lists with advance approval.

²These social sciences and humanities (SSH) electives must be chosen from a department-approved list and must include at least one 6-credit sequence of prerequisite or related courses. At least 6 credits of 200 level or above electives must be included.

³The IMSE curriculum provides students with the opportunity to obtain depth in a topic area of their choice. Two courses, selected from a department-approved list, must be taken from one of the following areas:

Operations Research: which is concerned with the design and analysis of quantitative models and methods having applications in production and service systems such as inventory control, scheduling, transportation, and logistics.

Manufacturing: which is concerned with the design, analysis, operation, and control of manufacturing processes and systems.

Human Factors: which is concerned with the relationships between people and their work tasks, machines, information, and environment.

Engineering Management: which is concerned with the strategies necessary for solving internal and external problems of a company in areas such as production, quality, project management, sales, and marketing strategies.

General: for students who did not want to specialize in any of the four focus areas above, can choose to combine electives from a number of areas.

Curriculum in Materials Engineering

Administered by the Department of Materials Science and Engineering.

Leading to the degree bachelor of science.

Total credits required: 123.5. See also *Basic Program and Cooperative Programs.*

Professional Program

Sophomore Year

Cr.	Fall
1	Integrated Materials Design—Mat E 213*
5	Introduction to Materials Science and Engineering—Mat E 211*
5	Introduction to Classical Physics I—Phys 221
3	Elementary Differential Equations—Math 266
14	
Cr.	Spring
3	Thermodynamics in Materials Engineering—Mat E 212*
3	Structural Characterization of Materials—Mat E 214*
5	Introduction to Classical Physics II—Phys 222
3	Statics of Engineering—E M 274*
3	SSH elective ¹
17	

Junior Year

Cr.	Fall
2	Integrated Materials Design—Mat E 313*
3	Kinetics and Phase Equilibria in Materials—Mat E 315*
3	Specialization I ² *
3	Specialization II ³ *
3	Mechanics of Materials—E M 324*
3	SSH elective ¹
17	
Cr.	Spring
3	Computational Methods in Materials—Mat E 316*
3	Mechanical Behavior of Materials—Mat E 318*
3	Specialization I ² *
3	Specialization II ³ *
3	SSH elective ¹
15	

Senior Year

Cr.	Fall
2	Integrated Materials Design—Mat E 413*
3	Specialization I ² *
3	Specialization II ³ *
3	SSH elective ¹
3	Technical elective ²
3	Free elective ⁵
17	

Cr.	Spring
2	Materials Engineering Design—Mat E 414*
3	Specialization I ^{2,6} *
3	Specialization II ^{3,6} *
3	SSH elective ¹
3	Technical elective
14	

English Proficiency

The Department of Materials Science and Engineering requires a grade of C or better in Engl 104 and 105 and certification from the departmental curriculum committee.

¹Social sciences and humanities (SSH) electives must be departmentally approved.

²Course in first area of emphasis (specialization).

³Course in second area of emphasis (specialization).

⁴Technical electives must be department approved.

⁵The free elective may be SSH, Technical, or other graded course.

⁶If Electronics is chosen as a specialization, then this course is 4 credits and the technical elective credit is reduced to 2 credits.

*Core professional curriculum. A student must have a minimum grade-point average of 2.00 in this group of courses in order to graduate.

Areas of specialization from which a student selects two:

Ceramic Materials 321, 322, 423, 424
Electronic Materials 331, 332, 433, 431
Metallic Materials 341, 342, 443, 444
Polymeric Materials 351, 352, 453, 454

Curriculum in Mechanical Engineering

Leading to the degree bachelor of science.

Total credits required: 128.5. See also *Basic Program and Cooperative Programs.*

Sophomore Year

Cr.	First Semester
4	Calculus III—Math 265
5	Introduction to Classical Physics II—Phys 222
5	Statics and Mechanics of Materials—E M 306*
2	Principles of Materials Science and Engineering—Mat E 272
R	Mechanical Engineering Seminar—M E 202
16	

Second Semester

Cr.	Second Semester
4	Elementary Differential Equations and Laplace Transforms—Math 267
3	Dynamics—E M 345*
3	Engineering Statistics—Stat 305
3	Introduction to Mechanical Engineering Design—M E 270*

3 Engineering Thermodynamics I—
M E 231*

16

Junior Year

Cr. First Semester

3 Engineering Thermodynamics II—
M E 332*

4 Manufacturing Engineering—M E
324*

3 General Education electives¹

3 Technical Communication—Engl
314

2 Introduction to Circuits and
Instruments—E E 442*

2 Introduction to AC Circuits and
Motors—E E 448*

17

Cr. Second Semester

4 Mechanism and Machine
Design—M E 325*

3 Engineering Measurements and
Instrumentation—M E 370*

3 General Education elective¹

3 Technical elective²

4 Fluid Flow—M E 335*

17

Senior Year

Cr. First Semester

4 Mechanical Systems and
Control—M E 421*

3 General Education elective¹

4 Heat Transfer—M E 436*

6 Technical electives²

17

Cr. Second Semester

3 Design elective³

6 Technical electives²

6 General education electives¹

15



English Proficiency

The department requires a minimum of C– in both Engl 104 and 105 with at least a 2.00 average for the two courses.

¹ General Education electives must be chosen from departmental-approved lists and must include Econ 101, at least six credits in the humanities and at least six credits in the social sciences. Students must select courses that also satisfy the diversity and international perspective requirement of the university. No more than three 100 level courses are allowed.

² All technical electives must be chosen from a department-approved list. Students must take a minimum of six credits of electives identified on the approved list as mechanical engineering technical electives. Suggested areas of specialization are the following:

Energy conversion and utilization—M E 444, 446, 447, 448, 449; E E 456, 457; I E 305.

Machines and systems—M E 410, 411, 412, 414, 415, 417, 418, 419, 420, 466, 490F, 511, 515, 516, 518, 549; E M 514, 515, 517, 518, 519, 525, 544, 584.

Materials and Manufacturing—M E 411, 490G, 515, 520, 521, 522, 523, 526, 529; E M 514, 544; Mat E 318, 443, 444; M S E 524.

Thermal and environmental engineering—M E 441, 442, 444, 445, 446, 447, 475, 490D, 490J, 490K, 530, 531, 532, 533, 536, 538, 540, 542, 545, 546, 547, 548, and applicable courses in other departments.

Propulsion—M E 445, 447, 448, 449, 490J, 490K, 490L, 542, 548; Aer E 411.

Nuclear Power—M E 431, 432.

³The design elective must be chosen from M E 415, 442, 446, 449 or 466.

*Core professional curriculum. A student must have a minimum grade-point average of 2.00 in this group of courses in order to graduate. electives must be department approved.

College of Family and Consumer Sciences

Carol B. Meeks, Dean
Beverly J. Crabtree, Emeritus Dean
Ruth E. Deacon, Emeritus Dean
JaneAnn Stout, Associate Dean
Suzanne Hendrich, Associate Dean
Mary Winter, Associate Dean

Departments of the College

Family and Consumer Sciences Education and Studies
Food Science and Human Nutrition
Hotel, Restaurant, and Institution Management
Human Development and Family Studies
Textiles and Clothing

The College of Family and Consumer Sciences (CFCS) advances the well-being of families and consumers over the life span. This is accomplished through teaching by helping students strive toward their career goals, through research by seeking solutions for today's critical social issues, and through outreach by sharing knowledge with individuals and groups at the local, state, national and international levels. The development and care of the personal sphere of human life is promoted so that society progresses harmoniously. This personal sphere is sustained and improved through the College by expanding knowledge related to emotional support, nurturance, food, clothing and shelter. Public policies, educational systems and business enterprises that support the personal sphere are also central to the College. The fields of study encompassed by the College are represented within the departments described above. The College faculty and staff work to create and communicate knowledge not only in a given field, but to combine that knowledge into an integrated whole. Each part of that whole is needed to achieve the goal of enhancing people's lives.

Students in CFCS learn how to contribute to the well-being of society through a variety of careers. At the baccalaureate level, students are prepared to become family and consumer science educators, early childhood educators, childcare providers, housing specialists, personal financial managers, apparel designers, merchandisers and entrepreneurs; also restaurant, hotel and institution managers; food scientists, dietitians and nutritionists. They also are prepared to pursue postbaccalaureate education at other institutions in such areas as social work, law, medicine or other health care professions. In addition, the College offers masters and doctorate programs in each department. Graduates are prepared for careers as researchers, educators, marriage and family therapists, or upper level managers in our professional fields.

The College of Family and Consumer Sciences aspires to create personal well-being. The College is committed to a love of learning and to nurturing students through rigorous and

dynamic curricula. The College provides extensive extracurricular opportunities, both local and international, for the personal and professional development of students. These commitments are the foundation for becoming the best FCS College in the nation.

Accreditation

All degree programs in the College of Family and Consumer Sciences are accredited by the American Association of Family and Consumer Sciences (AAFCS). Accreditation includes commitment to self-regulation, ongoing self-study, peer and external evaluation, and regular review by the Council for Accreditation for the AAFCS. These accreditation activities ensure that graduates of the College of Family and Consumer Sciences have had educational experiences of high quality and relevance as judged against nationally accepted standards. Throughout the United States, only a small number of colleges and universities offering bachelors degrees in Family and Consumer Sciences meet the high standards of the AAFCS accreditation.

In addition to the College accreditation, the following program-specific accreditation/registrations have been attained by Departments within the College:

Department of Family and Consumer Sciences Education and Studies:

Family and Consumer Sciences Education Teacher Licensure Program by the Iowa Department of Education and the Iowa Board of Educational Examiners.

Department of Food Science and Human Nutrition:

Food Science and Technology by the Institute of Food Technologists;
Dietetics Internship is developmentally accredited by the by the American Dietetic Association.

The Iowa State University Didactic Program in Dietetics is currently granted approval status by the Commission on Accreditation/Approval for Dietetics Education of The American Dietetic Association, 216 W. Jackson Blvd., Chicago, IL 60606-6995, 312/899-4876.

Department of Hotel, Restaurant, and Institution Management:

by the Accreditation Commission for Programs in Hospitality Administration, the accrediting agency of the Council on Hotel, Restaurant, and Institutional Education.

Department of Human Development and Family Studies:

Early Childhood, Birth - Grade 3 by the Iowa Department of Education;
Early Childhood Education-Unified by the Iowa Department of Education;
Marital and Family Therapy by the Commission on Accreditation for Marriage and Family Therapy Education;
Child Development Laboratory by the National Academy for Early Childhood Programs;

Financial Counseling and Family Resource Management curricula by the Association for Financial Counselors and Planning Education.

Department of Textiles and Clothing:

Production focus of the Apparel Merchandising, Design, and Production major by the Education Committee of the American Apparel Manufacturers Association.

Curricula in Family and Consumer Sciences

The College of Family and Consumer Sciences is fully accredited by the American Association of Family and Consumer Sciences Council for Accreditation. The curricula are planned to meet a variety of academic interests, abilities, and goals of the student. Each curriculum requires depth in a discipline. Breadth is acquired through general education and careful use of electives.

Apparel Merchandising, Design, and Production—Options: Merchandising; Design; Production

Child and Family Services—Options: Child Services; Family Services

Dietetics

Early Childhood Education

Family and Consumer Sciences Education and Studies—Options: Education (teacher licensure or educational services); Studies (international or general)

Family Resource Management and Consumer Sciences—Options: Family Resource Management and Consumer Sciences; Family Financial Counseling

Food Science—Options: Food Science and Technology; Consumer Food Science; Food Science and Industry

Hotel, Restaurant, and Institution Management

Housing and the Near Environment

Nutritional Science

Minors

Minors are available to all Iowa State students including family and consumer sciences majors. Minors consist of at least 15 specified credits and are available in the following areas: Apparel Merchandising, Design, and Production

Child and Family Services

Educational Services in Family and Consumer Sciences

Family Resource Management and Consumer Sciences

Food Science

Gerontology (interdisciplinary minor)

Hotel, Restaurant, and Institution Management

Housing and the Near Environment

Nutrition

See *Index* for minor requirements for specific departments.

Special Interest Programs

International and Cross Cultural Programs

Study abroad opportunities are available and encouraged through the College of Family and Consumer Sciences to broaden international and cross-cultural perspectives. Scholarships and other forms of financial assistance are available which provide partial support for students studying abroad. The college has established programs with Glasgow Caledonian University, Glasgow, Scotland; University of Otago, Dunedin, New Zealand; University of Northumbria at Newcastle, Newcastle upon Tyne, England; and the International College of Hospitality Administration, Brig, Switzerland. Students also study at the London College of Fashion, London, England, and participate in group study abroad programs to Europe, Africa, Costa Rica, and Mexico. Other opportunities may be developed through consultation with the associate dean of undergraduate programs and the student's adviser; for example, students have acquired internships and studied in such countries as Spain, Puerto Rico, Ireland, Guatemala, Switzerland, England, Australia, Germany, and France. Faculty members bring diversity and global perspectives to instruction and research, through their work in the Pacific Rim, India, South Korea, Latin America, Asia, Africa, and many countries in Europe.

Families Extension

Students may prepare for a career in the Cooperative Extension Service by enrolling in any curriculum in the College of Family and Consumer Sciences that provides them with a broad subject matter base for conducting educational programs for families. Courses should include C I 333, FCEdS 306, and 306L. Advice on choice of additional courses should be sought from the associate dean and director of Iowa State University Extension to Families programs, the director of Iowa State University Extension to Youth and 4-H programs, or the assistant to the vice provost for Extension, Human Resources Office.

Honors Program

High ability students, with a grade point average of above 3.35, are invited to apply to the Honors Program. Honors students are encouraged to develop a creative program of study expanding their interests while meeting individual educational objectives. Students in the Honors Program also participate in University Honors Seminars and complete an honors project. For further information, contact the College Honors Committee or academic adviser. Also see Index, Honors Program.

Dietetic Internship (DI)

This postbaccalaureate program, administered by the Department of Food Science and Human Nutrition, has received developmental accreditation from the American Dietetic Association (ADA). The purpose of the program is to enable those who meet the academic requirements of the ADA to obtain at least 900 hours of practice supervised by registered dietitians in medical nutrition therapy, community nutrition, and foodservice management to meet ADA performance requirements for entry

level dietitians. Students who satisfactorily complete the DI will be eligible to take the national registration examination administered by the Commission on Dietetic Registration (ADA).

Open Option Status

The College of Family and Consumer Sciences offers an open option for entering students who have not selected a specific area of study. Family and Consumer Sciences Orientation (FCEdS 110) helps students explore the opportunities available. Program planning information can be obtained from general college advisers.

Secondary School Preparation

Preparation required for admission is: 4 years English/language arts; 3 years mathematics; 3 years science; 2 years social studies.

Advising System

Each student in the College of Family and Consumer Sciences works closely with an academic adviser. Freshmen are advised by general college advisers. After the freshman year, each student is assigned a faculty adviser in the department of the chosen curriculum. Freshmen and sophomore students in Food Science and Human Nutrition are advised by a departmental adviser. The adviser assists the student in making adjustments to the university and provides information and guidance on course work, opportunities for professional and personal development and career choices.

Planned Transfer Programs

By careful planning with the College of Family and Consumer Sciences Academic Programs Office, students may begin their education at another college, then transfer their courses to a curriculum within the College of Family and Consumer Sciences with maximum efficiency in meeting the degree requirements. The College has developed program-to-program transfer plans with community colleges in Iowa and surrounding states. In addition, personalized plans may be developed for students attending other colleges. For more information, call 1-800-522-0683 or contact the associate dean for undergraduate programs, College of Family and Consumer Sciences, 124 MacKay, Iowa State University.

Preparation for Graduate Study

Students considering graduate studies should gain background knowledge in basic subjects related to their area of interest. Undergraduate mathematics, statistics, and research methods courses are useful as preparation for advanced study in graduate school. Upon completion of graduate programs, students are qualified for leadership positions in public and private institutions and for teaching, research, and extension positions in colleges and universities.

Professional Opportunities in Family and Consumer Sciences

Employment of Family and Consumer Sciences graduates remains at a high level. The flexibility of College of Family and Consumer Sciences programs allows for a wide range of career opportunities in diverse areas such as government, industry, education, health and human services, business, extension, and community agencies. A few

examples of the positions in these various fields are: dietitian; housing specialist; vocational family and consumer sciences teacher; infant, preschool, or special education teacher; hotel, club, or restaurant manager; financial counselor; apparel merchandiser, designer, or production specialist; food or textile researcher; sales representative; early childhood educator; consumer product specialist; and supervisor for a human service agency. Some students prepare for professional programs such as medicine, law, or health administration while pursuing a B.S. degree. The strength of the College programs lies in its capacity to enhance the graduate's ability to develop and deliver products, programs, or services to families and consumers, as well as to strengthen the communication and leadership skills needed in representing the interests of families and consumers.

The Career Services Office delivers a broad range of services to help students in the job search process. Students learn to identify their strengths, interests, and values related to professional goals and to match them to career opportunities. Students learn to write resumes and letters, network with professionals, and develop interviewing skills. Technologically up-to-date services such as Web Walk-up facilitate contacts with potential employers using resume referrals, a "Positions Available List," on-campus recruiting, and an annual College Career Week. The Career Services Office maintains a resource center of career related materials and employer information.

General Education

Each department within the college requires students to select and/or elect courses to fulfill a specific number of credits in prescribed areas.

Minimum Group Requirements in the College of Family and Consumer Sciences

Cr.	
9.5	I. Communications and Library
9	II. Natural sciences and mathematical disciplines
9	III. Social sciences
9	IV. Humanities
8	V. Family and Consumer Sciences*

Independent Study

Students may pursue independent work by enrolling in 490 courses in individual departments. No more than a total of nine semester credits of independent study may be applied to a degree in family and consumer sciences.

*Assumes additional credits will be necessary for meeting the objectives of the College of Family and Consumer Sciences, including the areas of management, aesthetics, educational principles, public policy, and requirements in specific degrees.

Curriculum in Apparel Merchandising, Design, and Production

Administered by the Department of Textiles and Clothing. Leading to the degree bachelor of science. **Total credits required: 123.5** including a minimum of 18 credits in T C at Iowa State University for the degree.

The major in apparel merchandising, design, and production provides a broad based program of study with flexibility in creating program options. Courses are required in the following groups: general education, family and consumer sciences core, and textiles and clothing core. To complete the program, a student combines structured clusters of courses to form primary and secondary program options.

A minor in apparel merchandising, design, and production is available; the requirements appear under *Textiles and Clothing, Courses and Programs*.

Cr. Degree Requirements

- 12.5 Communications and library**
 6.5 Engl 104, 105; Lib 160
 3 Select from Engl 302, 309, 314
 3 HD FS 370 or Sp Cm 212
- 14-18 Natural sciences and mathematical disciplines**
 3-5 Select from biology, chemistry, geology, physics, zoology

- 3-4 Mathematics (Math 150 recommended for Merchandising and Production Options)
 4 Com S 103
 4-5 Stat 101 or 227
 9 **Social sciences**
 3 Econ 101
 6 Select from the approved FCS list
 9 **Humanities**
 Select from the FCS-approved list (all T C courses excluded except 257 and 342). Must include one history course; foreign language recommended.
 8 **Family and consumer sciences core**
 FCEdS 110, 160, 310, 460; FS HN 167; HD FS 102

Professional courses

- 34-35 Textiles and clothing core**
 25 T C 131, 165, 204, 231, 245, 375, 380 or 381, 410
 3 Human studies
 Select from T C 354, 355, 467
 3-4 Product development
 Select from T C 225, 305, 321, 331, 404
 3 International
 T C 362 or 472

Primary option areas

Select one cluster from primary option areas

- 15-16 Merchandising**
 6 T C 376; Acct 284
 9-10 Select three courses from T C 278, 377, 470, 472; JI MC 330; Mkt 340, 410, 446; Mgmt 370, 371
 17 **Design**
 11 T C 121, 225, 278, 395, 495
 6 Select two courses from T C 321, 325, 326, 354, 355, 468, 470
 16 **Production/Apparel Engineering**
 16 T C 331, 470; Acct 284; I E 271, 375

Secondary option areas

Select a second cluster from the remaining primary option areas or from the secondary option areas

- 9-10 Business**
 3 T C 472
 6-7 Select from Acct 285; Econ 301, 355, 385; Fin 350; Mgmt 318, 370; Trlog 360
 9 **Consumer behavior/marketing**
 6 T C 467; Mkt 340
 3 Select from T C 470, 499; HD FS 210; Hist 376; JI MC 203, 205, 320, 330; Mkt 341, 410, 442, 444, 446, 447
 9 **Creative Design**
 3 T C 326
 6 Select from T C 321, 325, 355, 404; Art 130, ArtCD 227, 343, 344, 345, 346, 347. ArtVS 208;
 9 **History**
 6 T C 354, 355
 3 Select from T C 257, 362, 470, 499; art history
 9 **Human relations/communications/management**
 9 Select three courses from T C 467, 470, 499; ComSt 310, 314, 317, 318; HD FS 370; Mgmt 370, 371; Psych 450, Soc 380, Sp Cm 212
 9 **Product development**
 9 Select three courses from T C 121, 225, 305, 321, 326, 331, 325, 404, 467, 468, 470, 499
 9-10 **Quality assurance**
 6 T C 305, 331
 3-4 Select from T C 404, 470, 499; I E 271, 361, 476; I Tec 360; Stat 495
 9 **International Trade**
 3 T C 362 or 472
 Choose 6-8 credits from one foreign language or 6 credits from T C 381, Anthr 323, 326; FCEdS 421, IntSt 120, 220, 235, 320, 420; Mgmt 414; Mkt 448; T SC 341

Electives

Select courses to broaden or complement the options (see adviser).
 123.5 Total credits

Curriculum in Child and Family Services

Administered by the Department of Human Development and Family Studies. Leading to the degree bachelor of science. **Total credits required: 128.5.**

The child and family services curriculum prepares students for professional work with children and families in a variety of public and private human service agencies and organizations. Examples include schools, child care programs, services to the elderly, community action, and crisis intervention. A minor in child and family services is available; the requirements appear under *Human Development and Family Studies, Courses and Programs*.



- Cr. Degree Requirements**
- 12.5 Communications and library**
9.5 Engl 104, 105; Lib 160; Sp Cm 212
3 Select from Engl 302, 309, 310, 314
- 12-14 Natural sciences and mathematical disciplines**
3-4 Stat 101* or Math 105, 140, 142, 150, 165, 195
3 Zool 155** or 258
3-4 Com S 103 or C I 201
3 Select from natural sciences or statistics
- 9 Social sciences**
Select from American history, anthropology, economics, political science, psychology, sociology
- 9 Humanities**
Select from approved list.
- 8 Family and consumer sciences core**
FCEdS 110, 160, 310, 460; FS HN 167; HD FS 102
- 17 HD FS core**
14 HD FS 269, 449, 491
3 Select HD FS other than child or family services option
- 18 Related Disciplines**
Select from anthropology, business, economics, education, gerontology, health studies, family resource management, housing and the near environment, child services or family services, political science, psychology, sociology, speech communication
- 35 Child services option**
30 HD FS 218, 220, 221, 226, 240, 340, 343, 345, 445; Sp Ed 250
3 Select from HD FS 276, 349, 367, 395 or 460
2 Select from H S 105, 110, 115, 292 or 310
- 28 Family services option**
4 HD FS 218, 479
24 Select from HD FS 276, 317B, 349, 360 or 463, 367, 370, 373, 377, 378, 380, 395, 490A

Child Services Option

- 120.5-122.5 Total requirements
6-8 Electives
128.5 Total Credits

Family Services Option

- 113.5-115.5 Total requirements
13-15 Electives
128.5 Total credits

*Required in Family Services option.

**Biology 109 recommended before Zoology 155 for students without high school biology and chemistry.

Curriculum in Dietetics

Administered by the Department of Food Science and Human Nutrition.

The student is prepared for admission to dietetic internship programs and other professional experience programs approved/accredited by The American Dietetic Association.



Courses included have been approved as meeting the academic requirements of The American Dietetic Association. There is a \$30 fee for a statement of verification of completion of the approved program.

- Cr. Degree Requirements**
- 9.5 Communications**
Engl 104, 105; FCEdS 310*; Lib 160; Sp Cm 212
- 6-7 Mathematical sciences**
3 credits in college-level math; Stat 101 or 104
- 9 Physical sciences**
Chem 163, 163L, 231, 231L
- 18 Biological sciences**
BBMB 301, 311; Biol 201, 202, Micro 201; Zool 155, 156
- 9 Social sciences**
Econ 101; HD FS 102 or Psych 230*; Psych 101
- 9 Humanities**
Includes 3 cr. of international perspectives and 3 cr. of ethics**
- 39.5 Food science and human nutrition**
FS HN 110,* 167,* 203,* 214, 261, 340, 360, 361, 362, 403, 411, 461, 463, 464, 466, 480*
- 11 Management**
HRI 380, 380L, 391, 392
- 8-9 Electives
- 120 Total credits**

*These courses fulfill the requirement for CFCS core.

**See department for procedures to meet requirements.

Curriculum in Early Childhood Education

The curriculum in early childhood education is planned for students preparing to teach young children and work with their families. This program leads to careers in working with young children who are typically developing and those with special needs from birth through age eight. Graduates in this curriculum may teach in early childhood (preschool and primary) classrooms and home based programs, with emphasis on inclusive services; graduates may be employed by either public or private agencies or schools. This curriculum has been approved by the Iowa Department of Education and meets the requirements for the

early childhood education unified teacher license, which permits individuals to teach general and special education for children from birth through age eight. The program is administered jointly by the Department of Curriculum and Instruction within the College of Education, and the Department of Human Development and Family Studies within the College of Family and Consumer Sciences.

Cr. Degree Requirements

- 42.5 General education**
- 12.5 Communication skills
Engl 104, 105, Lib 160, Sp Cm 212, select from communications options list
- 12 Natural sciences and mathematics
FS HN 167, Math 195, select 3 credits from physical sciences and 3 credits from biological sciences
- 9 Social sciences
American history or American government, select from approved list
- 9 Humanities
Select from approved list
- 2 Health, dance, physical education, safety
H S 105
- 16 Human development and family studies**
- 9 HD FS 102, HD FS 220, HD FS 221
3 Select from HD FS 349, 395, 445, 449, 460
Orientation: FCS or Educ
FCEdS 110 or C I 115 or 315 and FCEdS 310 or C I 215
- 14 Professional education core**
C I 201, 204, 406, Sp Ed 250, Psych 333
- 21 Preprimary: Inclusive
HD FS 240, 340, 343, 345, 455, 456
- 21 Primary: Inclusive
C I 245, 268, 367, 433, 438, 439, 468F, 468G, 468I, Sp Ed 368, 355, 455
- 16 Student teaching: preprimary and primary (inclusive)
Sp Ed 415 and HD FS 417B or C I 416A and HD FS 417C
- 128.5 Total requirements**
0 Electives
128.5 Total credits

Curriculum in Family and Consumer Sciences Education and Studies

Administered by the Department of Family and Consumer Sciences Education and Studies. Leading to the degree bachelor of science. **Total credits required: 128.5.**

This curriculum provides a broad-based program of study focusing on preparation for

professional careers related to education or community participation. Courses are required in general education, the family and consumer sciences core, and the departmental core. Students select a primary and a secondary program option.

There are two choices for this curriculum. Primary Option 1, education and Primary Option 2, studies. For each primary option area, a secondary option must also be chosen; teacher licensure or educational services in education and international or general in studies. In all options, students are prepared with a broad-based understanding of family and consumer sciences.

Primary Option 1, education, is designed for students seeking careers as family and consumer sciences educators in a variety of settings such as middle, junior, and senior high schools (teacher licensure); and extension, business, community agencies, community colleges, and adult education programs (educational services). With additional credits in teacher licensure, students may also be approved to teach in specific occupational areas: child care, fashion merchandising, and foodservice. Further information about licensure programs appears under *College of Education*.

Primary Option 2, studies, is designed for students seeking careers in international settings and/or planning for involvement in international programs and activities (international); or to provide students with the opportunity to pursue an individualized program which is planned with their academic advisers (general).

The department offers a minor in educational services in family and consumer sciences; the requirements appear under Family and Consumer Sciences Education and Studies, Courses and Programs.

Cr.	Degree Requirements
9.5	Communications and library
6	Engl 104, 105
3	Sp Cm 212
0.5	Lib 160
9	Natural sciences and mathematical disciplines
3	Select a course from the mathematical disciplines (Teacher licensure option must select Math course)
3	Select additional course(s) in natural science. (Both teacher licensure option and educational services option must complete 5 credits of Chem 163, 163L)
3	Zool 155 or Biol 109
9	Social sciences
3	Econ 101 or 102
3	Soc 134
3	Select from anthropology, economics, psychology, sociology
9	Humanities
3	Select from American history or American government
9	Courses from approved list (Teacher licensure option: must complete 3 credits of American history or political science)

8	Family and consumer sciences core
2	FCEdS 110, 160, 310, 460
3	FS HN 167
3	HD FS 102 or Psych 230
11	Family and Consumer Sciences Education and Studies core
	FCEdS 206, 306, 379, 421

Primary Option 1. Education

24-26	Additional professional courses
3	Select from Anthr 317; HD FS 210; T C 342, 362
3-5	FS HN 211 or 214
1	FCEdS 206L
12	HD FS 220, 221 or 226; 239, 283 or 483; 378
3	T C Select one course
(+2)	Chem 163, 163L (use as natural sciences)

Secondary Option 1A-Teacher Licensure

	American History or government (use as humanities)
6	HD FS 349, 488
23	FCEdS 318, 403, 413, 417A, 417B
14	C I 201, 204, 333, 406, 415, 426
4-6	Electives

Secondary Option 1B-Educational Services

3	Engl 302, 309, 313, 314, or Sp Cm 312
3	HD FS 370
6	Courses in FS HN, HRI, HD FS, T C
13	FCEdS 314, 415, 418A
2-3	HRI 287, Mgmt 370, or Mkt 340
3	JI MC 205
16-19	Electives
128.5	Total credits

Primary Option 2. Studies

36	Additional professional courses
5-10	FCEdS 314, 418B
3	HD FS 283 or 378
3	Select from Anthr 317; HD FS 210; T C 342, 362; Phil 340
20-25	Select from FCS

37 Secondary Option 2A-International

6	Anthropology or political science of region
3	Anthr 313
3	Anthr 311 or Soc 411
3	History of region
3	FS HN 342, HD FS 575, or T C 362
6	IntSt 235, 430
3	T SC 341
10	Electives
	Demonstration of language proficiency

37 Secondary Option 2B-General

14	Natural sciences, social sciences, humanities, art and design
3	Engl 302, 314; JI MC 205; or Sp Cm 312
20	Electives
128.5	Total credits

Occupational teaching areas available:

Child care: HD FS 220, 221, 343, 445, 447
Fashion merchandising: T C 131, 165, 375, 376; Acct 284; Com S 103
Foodservice: Biol 109; Micro 201 or HRI 293; HRI 380, 380L, 434, 438

Curriculum in Family Resource Management and Consumer Sciences

Administered by the Department of Human Development and Family Studies. Leading to the degree bachelor of science. **Total credits required: 128.5.**

This curriculum focuses on the behavior of families as they allocate and manage their resources and function as consumers. Upon graduation, the student will be prepared to advise clients in the wise use of personal resources, in effective money management, and in sound financial planning. A minor in family resource management and consumer science is available; the requirements appear under *Human Development and Family Studies, Courses and Programs*.

Cr. Degree Requirements

12.5	Communications and library
9.5	Engl 104, 105, Sp Cm 212, Lib 160
3	Select from Engl 302, 309, 310, 314
13-14	Natural sciences and mathematical disciplines
6	Select from natural or biological sciences or mathematics or statistics
3-4	Com S 103 or 107
4	Stat 101
15	Social sciences
6	Econ 101 and 102
9	Select from anthropology, economics, political science, psychology, sociology
9	Humanities
	Select from approved list
8	Family and consumer sciences core
	FCEdS 110, 160, 310, 460; FS HN 167; HD FS 102
17	HD FS core
15	HD FS 269, 449, 491
3	Select HD FS other than family resources management curriculum

Option 1. Family Resource Management and Consumer Sciences

Cr.	Degree Requirements
15	HD FS 283, 378, 395, 483, 488
3	HD FS 380 or Acct 215
6	Select from HD FS 239, 341, 360, 370, 377, 448, 489
12	Select from accounting, economics, finance, history, journalism, management, marketing, political science, psychology, sociology
17-18	Electives
128.5	Total credits

Option 2. Family Financial Counseling

Cr.	Degree Requirements
34	HD FS 283, 341, 378, 483, 488, 489, 489L; Acct 284; Econ 353; HD FS 380 or Acct 215; Mkt 340 and 444

- 3 Select from HD FS 370, 395, 448, Soc 305, Psych 280
 16-17 Electives
 128.5 Total credits

Curriculum in Food Science

Administered by the Department of Food Science and Human Nutrition.

Option 1. Food Science and Technology

Cr.	Degree Requirements
9.5	Communications Engl 104, 105; FCEdS 310*; Lib 160; 3 additional credits in oral or written communication **
11-12	Mathematical sciences Math (165 and 166) or (181 and 182); Stat 101 or 104
23	Physical sciences Chem 177, 177L, and 178; Chem 331, 331L, 332; Phys 111, 112
13	Biological sciences BBMB 301; Biol 201, 202; Micro 201L, 302
9	Social sciences HD FS 102 or Psych 230*, 6 additional credits
9	Humanities Must include 3 cr. each of U.S. diversity and international perspectives**
34.5	Food science and human nutrition FS HN 110*, 167*, 203*, 311, 351, 403, 410, 412, 420, 421, 471, 472, 480* Select additional courses in FS HN at 200 level or above† (except 228) or An S 270, 360 or 470 to total 34.5 credits.†
10-11	Electives
120	Total credits

*These courses fulfill the requirements for CFCS core.

**See department for procedures to meet requirements.

†Credit allowed for FS HN 101 only if course taken prior to enrollment in or during the first year in FS HN Department.

Option 2. Food Science and Industry

Cr.	Degree Requirements
12.5	Communications Engl 104, 105; FCEdS 310*; Lib 160; 6 cr. from Engl 302, 305, 309, 314, 405, 415, 416, HD FS 370, JI MC 205; Advrt 230; Sp Cm 212
6-7	Mathematical sciences Math 151; Stat 101 or 104
13	Physical sciences Chem 163, 163L, 231, 232; Phys 106
12-13	Biological sciences Biol 201, 202; Micro 201 or 302, 201L; BBMB 301
9	Social sciences HD FS 102 or Psych 230*, 6 additional credits
9	Humanities

- Includes 3 cr. each U.S. diversity and international perspectives**
- 8-11 **Emphasis area: choose from business, commodity processing, public relations and mass communications, meat processing, food preparation and formulation, microbiology (see departmental approved list).**
- 37.5 **Food science and human nutrition**
FS HN 110*, 167*, 202, 203*, 311, 351, 403, 405, 410, 412, 420, 421, 471, 472, 480*
- 8-13 **Electives**
- 120 **Total credits**

*These courses fulfill the requirements for the CFCS core.

**See department for procedures to meet requirements.

Option 3. Consumer Food Science

Cr.	Degree Requirements
18.5	Communications Engl 104, 105, 302 or 314; FCEdS 310*; JI MC 205; Advrt 230; Lib 160; Sp Cm 212
6-7	Mathematical sciences 3 cr. college-level math; Stat 101 or 104
13	Physical sciences Chem 163, 163L, 231, 231L; Phys 106
15-16	Biological sciences Biol 201, 202; BBMB 301; Micro 201 or 302, 201L; Zool 155
12	Social sciences Econ 101; HD FS 102 or Psych 230*; Mkt 340, 447
9	Humanities Must include 3 cr. each in U.S. diversity and international perspectives.**
36.5	Food science and human nutrition FS HN 110, 167*, 203*, 214, 261, 311, 360, 403, 406, 411, 412, 420, 471, 480*
8-10	Electives
120	Total credits

*These courses fulfill the requirements for the CFCS core.

**See department for procedures to meet requirements.

Curriculum in Food Science and Technology-B.S./M.S.

Administered by the Department of Food Science and Human Nutrition.

Undergraduate Program:

Cr.	Degree Requirements
9.5	Communications and library Engl 104, 105; FCEdS 310*, Lib 160, 3 additional credits in oral or

- written communication**
- 11-12 **Mathematical sciences**
Math (165 and 166), (181 and 182), Stat 101 or 104
- 23 **Physical sciences**
Chem 177, 177L, 178, 331, 331L, 332, Phys 111, 112
- 16 **Biological sciences**
BBMB 404, 405; Biol 201, 202; Micro 201L, 302
- 9 **Social sciences**
HD FS 102 or Psych 230*; 6 additional credits
- 9 **Humanities**
Must include 3 cr. each in U.S. diversity and international perspectives**
- 34.5 **Food science and human nutrition**
FS HN 110, 167*, 203*, 311, 351, 403, 410, 412, 420, 421, 471, 472, 480*; additional credits in FS HN courses at 200-level or above (except 228) or An S 270, 360, 470 to total 34.5 cr.
- 7-8 **Electives**

120 **Total credits**

*These courses fulfill the requirements for the CFCS core.

**See department for procedures to meet requirements.

Graduate Program:

Cr.	Degree Requirements
30	Graduate-level coursework including research

Curriculum in Hotel, Restaurant, and Institution Management

Administered by the Department of Hotel, Restaurant, and Institution Management. Leading to the degree bachelor of science. Total credits required: 128.5.

The curriculum in Hotel, Restaurant and Institution Management prepares men and women for a variety of managerial positions in hotels, restaurants, clubs, university foodservice, and other types of institutions and establishments providing lodging and foodservice.

Cr.	Degree Requirements
12.5	Communications and library Engl 104, 105, 302; Lib 160; Sp Cm 212
12	Natural sciences and mathematical disciplines Chem 163, 163L; Math 104, 140 or 150; Stat 101
9	Social sciences Econ 101; Psych 101; Soc 134
11	Humanities A list of courses may be obtained from the departmental office. Must include an approved art principles course.

- 5 Family and consumer sciences
FCEdS 110, 160, 310, 460; HD FS 102
- 33-34 Hotel, Restaurant, and Institution management core
HRI 233, 287, 288, 333, 352, 380, 380L, 393 or 491, 433, 438, 440, 460
- 9 Hotel, Restaurant, and Institution Management electives
Select from HRI 289, 360, 383, 437, 439, 452, 455, 480, 485, 487
- 19 Other professional courses
Acct 215, 284; Com S 103; FS HN 167*, 211; Mkt 340
- 17-18 Electives
- 128.5 Total credits

*A student who has not had high school biology is required to take Biol 109.

Curriculum in Housing and the Near Environment

Administered by the Department of Human Development and Family Studies. Leading to the degree bachelor of science. **Total credits required: 128.5.**

The curriculum in housing and the near environment focuses on housing needs, issues and trends, such as housing alternatives for families and children; housing for the elderly and persons with disabilities; residential property management; and public policy. Graduates of this curriculum are prepared for employment in the housing industry, including housing-service organizations; public and private (profit and not-for-profit) agencies; real estate and lending institutions, housing management and administration; housing equipment/ furnishings industries; and housing advocacy. A minor in housing and the near environment is available; the requirements appear under *Human Development and Family Studies, Courses and Programs*.

- Cr. Degree Requirements**
- 12.5 Communications and library
9.5 Engl 104, 105; Sp Cm 212; Lib 160
3 Select from Engl 302, 309, 310, 314
- 9-11 Natural sciences and mathematical disciplines
3 Select from natural sciences
3-4 Select from mathematics or statistics
3-4 Select from computer science
- 9 Social science
Select from anthropology, economics, geography, political science, psychology, sociology
- 9 Humanities
select from approved list.
- 8 Family and consumer sciences core
FCEdS 110, 160, 310, 460; FS HN 167; HD FS 102
- 17 HD FS core

- 14 HD FS 269, 449, 491
- 3 Select HD FS other than housing curriculum
- 15 Housing
HD FS 317H, 341, 360, 460, 463
- 39 Related professional courses
- 12 Select from HD FS, T C, HRI, FCEdS, or FS HN
- 27 Select from accounting, anthropology, architecture, business administration, community and regional planning, design studies, economics, education, finance, gerontology, health studies, human development and family studies, interior design, political science, psychology, social work, sociology, speech communication
- 8-10 Electives
- 128.5 Total credits

Curriculum in Nutritional Science

Administered by the Department of Food Science and Human Nutrition.

- Cr. Degree Requirements**
- 9.5 Communications and Library
Engl 104, 105; FCEdS 310*; Lib 160; select 3 additional credits in oral or written communication**
- 7-8 Mathematical sciences
4 credits in calculus (2 semesters preferred); Stat 101 or 104
- 24 Physical sciences
Chem 177, 177L, 178, 331, 331L, 332; Phys 111, 112
- 22 Biological sciences
Biol 201, 201L, 202, 202L, 301, 302; Micro 201L, 302; Zool 355
- 9 Social Sciences
HD FS 102 or Psych 230*; 6 additional credits
- 9 Humanities
Must include 3 credits each in U.S. diversity and international perspectives**.
- 27.5-31.5 Food science and human nutrition
FS HN 110*, 203*, 214 or 311, 261, 360*, 362, 480*; select 14-16 credits from FS HN 361, 403, 419 or 519, 461, 463, 464, 466, 490C, 499, 560, 562, 565, 575
- 2-3 Management
HRI 287 or Mgmt 370
- 4-10 Electives
- 120 Total credits

*These courses fulfill the requirement for CFCS core.

**See department for procedures to meet requirements.

Curriculum in Nutrition B.S./M.S.

Administered by the Department of Food Science and Human Nutrition.

Undergraduate Program:

- Cr. Degree Requirements**
 - 9.5 Communications and library
Engl 104, 105; FCEdS 310*, Lib 160, select 3 additional credits in oral or written communication**
 - 7-8 Mathematical sciences
4 credits in calculus (2 semesters preferred), Stat 101 or 104
 - 24 Physical sciences
Chem 177, 177L, 178, 331, 331L, 332, 332L; Phys 111, 112
 - 20-22 Biological sciences
BBMB (404 and 405) or 420; Biol 201, 201L, 202, 202L; Micro 201L, 302; Zool 355
 - 9 Social sciences
HD FS 102 or Psych 230*; 6 additional credits
 - 9 Humanities
Must include 3 cr. each in U.S. diversity and international perspectives.
 - 27.5-31.5 Food science and human nutrition
FS HN 110*; 203*, 214 or 311, 261, 360*, 362, 480*; select 14-16 credits from: FS HN 361, 403, 419 or 519, 461, 463, 464, 466, 490C, 499, 560, 562, 565, 575
 - 2-3 Management
HRI 287 or Mgmt 370
 - 4-12 Electives
 - 120 Total credits
- *These courses fulfill the requirement for CFCS core.
**See department for procedures to meet requirements.

Graduate Program:

- Cr. Degree Requirements**
- 30 Graduate-level coursework including research

College of Liberal Arts and Sciences

Peter W. Rabideau, Dean
Zora D. Zimmerman, Associate Dean
Peter Orazem, Interim Associate Dean
J.D. Beatty, Assistant Dean
Ruth W. Swenson, Associate Dean Emerita

Departments of the College

Air Force Aerospace Studies
Anthropology
Biochemistry, Biophysics, and
Molecular Biology
Botany
Chemistry
Computer Science
Economics
English
Foreign Languages and Literatures
Geological and Atmospheric Sciences
Greenlee School of Journalism and
Communication
History
Mathematics
Military Science
Music
Naval Science
Philosophy and Religious Studies
Physics and Astronomy
Political Science
Psychology
Sociology
Statistics
Zoology and Genetics

In the College of Liberal Arts and Sciences, students select from a wide and rich range of program options. The goal of the college is to prepare the student to enter the world beyond the university with skills in reasoning, analysis, and communication; with an appreciation of history and culture, an understanding of the challenges of the future, and a sensitivity toward people and their environments. To achieve this goal, the college asks students to acquire depth in learning within disciplines of their own choice, by way of single or multiple majors and breadth through elective courses and courses fulfilling general education requirements.

The College of Liberal Arts and Sciences is the academic home, the foundation, for many essential learning disciplines. The college provides students with all the components of a modern liberal education. Students may choose to study in various fields of the physical, biological, and social sciences; in mathematical disciplines; in methods and systems of communication; and in the arts and humanities.

The flexible degree requirements in the curriculum in Liberal Arts and Sciences permit programs of study suited to a variety of interests and goals. Students having academic interests not fully met by a departmental major may pursue a major offered by one of the College's interdepartmental programs or may apply for an undergraduate major in interdisciplinary studies (See *Index, Liberal Arts and Sciences, Cross-Disciplinary Studies*). The college participates in the University Honors Program; thus, students of exceptional academic promise can develop unique and challenging programs of study.

The college has three curricula: a curriculum in Liberal Arts and Sciences, leading to the bachelor of arts or the bachelor of science degree; a curriculum in music, leading to the bachelor of music degree; and a curriculum in liberal studies, leading to the bachelor of liberal studies degree.

High School Preparation/ Admission Requirements

Students entering the college are required to present evidence of the following high school preparation:

4 years of English (Typically this preparation includes courses in British, American, and world literature in which critical reading and writing skills are emphasized and courses in speech and composition, including at least one senior-level writing course.)

3 years of social studies (Typically such preparation includes two semesters of world history, two semesters of American history, and a semester of American government. Electives can be chosen from areas such as economics, sociology, or psychology.)

2 years of a single foreign language (Three years or more of a single foreign language are strongly recommended for students who wish to continue their work in that language. Three years of a single foreign language will also exempt students from the foreign language graduation requirement in the College of Liberal Arts and Sciences.)

3 years of mathematics (Such preparation shall include two semesters of beginning algebra, two semesters of geometry, and two semesters of intermediate algebra. A fourth year of study involving analytic geometry, trigonometry, linear algebra, and/or calculus is strongly recommended for students who will major in mathematical or scientific disciplines.)

3 years of science (At least two years of such preparation shall be chosen from biology, chemistry, and physics.)

Recommended but not required as a condition of admission to the College of Liberal Arts and Sciences is one semester of computer science. (Such a course should stress problem-solving with computers and should not substitute for courses in mathematics. In schools

where computer use is an integral part of most courses, separate instruction in computers is not necessary.)

Students who transfer from another college or university with at least 24 credits of satisfactory coursework may be exempt from most of these requirements. Students who do not meet the requirements listed here may be admitted with a limited number of deficiencies, provided that they can be removed by the end of the first academic year. Iowa State courses taken to remove deficiencies are subject to certain restrictions with regard to their applicability to students' college degree programs. Contact the college office for further information about these restrictions and about remedying deficiencies in general.

Transfer Students

To graduate from the College of Liberal Arts and Sciences, a transfer student must complete the general requirements of the college as well as those of the university. Students planning to transfer to Iowa State University for the purpose of enrolling in the College of Liberal Arts and Sciences are advised to contact the college office for information concerning degree program requirements. Prospective transfer students are urged to learn about the academic programs that are of interest to them well before arriving on campus so that pretransfer courses are appropriate to the planned major and transferable toward graduation from ISU. Additional information concerning transfer credit evaluation may be obtained through the Office of Admissions as well as the department in which a student is interested.

A transfer student in the College of Liberal Arts and Sciences may choose to graduate under the catalog in effect at the time of his or her graduation or under one of the two immediately preceding catalogs, provided that it covers the period of his or her enrollment either at Iowa State or any other accredited school. Full requirements of the chosen catalog must be met except that adjustments will be made in instances where courses are no longer available or where programs have been changed. A transfer student is responsible for reviewing his/her transfer credit evaluation with the academic adviser during the first semester of enrollment.

University Requirements

The university requirements for the bachelor's degree, including statements of academic standards, the university residence requirement, the English proficiency requirement, U.S. diversity and international perspectives requirement, and the library requirement, appear in the Colleges and Curricula portion at the beginning of this bulletin.

Curriculum in Liberal Arts and Sciences

To obtain a bachelor's degree from the College of Liberal Arts and Sciences, curriculum in liberal arts and sciences, an undergraduate student must earn a minimum of 124.5 semester credits including a minimum of 32 semester credits earned in residence at Iowa State University. In addition, the student must meet general education, English proficiency, library proficiency, foreign language, and advanced credit requirements, as well as the requirements of a major. Courses taken on a pass/not pass basis may be counted toward the required total of 124.5 credits, and may be used to meet the advanced credit requirement, if appropriate, but may not be used to satisfy any other graduation requirement. No more than 9 credits of 490 (Independent Study) courses in a single discipline may be counted toward graduation.

General Education Requirements

Students must earn the minimum credits listed in each of the four general education groups in courses outside the department of the first major listed on the degree program. Interdisciplinary courses may be used to satisfy requirements in any group for which they have been approved, but a student may not apply the same course to more than one group.

Credit by Examination Program

Individual departments may use CLEP Subject Tests for testout of specific courses. Students in the College of Liberal Arts and Sciences may use CLEP General Test credits as free electives but not toward any of the general education group requirements.

General Education Groups

I. Arts and humanities (minimum 12 credits). The student should develop an understanding of human cultural heritage and history, and an appreciation of reasoning and the aesthetic value of human creativity.*

II. Verbal communication (minimum 2 credits). The student should develop skill in and an understanding of the principles involved in effective communication among people.*

III. Natural sciences and mathematical disciplines (minimum 11 credits including 3 in the mathematical disciplines and 8 in the natural sciences). The student should experience science as a rational search for understanding the structure and behavior of the natural world, and should appreciate mathematics as a valuable tool of the sciences and as an intrinsically important way of thinking.*

IV. Social sciences (minimum 9 credits). The student should develop an appreciation of the principal methods of studying human behavior and an understanding of the structure and

functioning of institutions. Courses must be taken in at least two disciplines represented in Group IV.*

*Lists of approved courses are available from advisers or the Office of the Dean, College of Liberal Arts and Sciences.

Other Requirements

English Proficiency

The faculty of Iowa State University believes that its graduates should acquire competence in written communication during their undergraduate careers. All students must earn an average grade of C- or better in required basic composition courses (e.g., Engl 104 and 105). This should be regarded as a minimally acceptable grade standard. Departments may have stricter criteria as appropriate to their disciplines.

The continued development of communication skills following the freshman year is the responsibility of the student's major department. The department shall promote this development by adopting measures to certify the writing proficiency of its own majors. Certification is to occur a reasonable time before graduation and shall be based upon satisfactory completion of a designated course in the student's program in which writing is evaluated or an advanced writing course offered in the English department (e.g. Engl 302, 305, or 314).

Library Proficiency

A library minimum proficiency requirement must be met by satisfactory completion of one of the following options:

1. Library 160
2. A test-out examination for credit to be administered by the library staff, who will control the testing procedure and will determine those students who are eligible to take the examination.

Foreign Language Requirement

The faculty of the College of Liberal Arts and Sciences believes that undergraduate students should acquire elementary practical experience in a second language, should be introduced to the theoretical study of language structure, and should begin to develop an understanding of a second culture through study of that culture's language. As a means of achieving this objective, a student must satisfy a graduation requirement equivalent to the first year of university-level study in one foreign language (normally, completion of a two-semester sequence in any one foreign language).

The requirement may be met by completion of three or more years of high school study in one foreign language. To make this feasible, prospective students are encouraged to begin foreign language training as early as possible in their academic careers. Students who have a strong foreign language preparation may attempt to acquire college credit by taking the test-out examination administered each semester by the Department of Foreign Languages and Literatures.

Students who have completed two years of high school study in one foreign language may

choose to satisfy the foreign language requirement by (a) satisfactory performance on the foreign language examination administered by the Department of Foreign Languages and Literatures, (b) passing each course of a two-semester university-level sequence (101, 102) or equivalent (160, 110), or (c) passing any one semester of a foreign language course at the 200 level or higher. (Courses taught in English are excluded from being used in this manner.) Certification in American Sign Language is recognized by Iowa State University and will be accepted in meeting the foreign language requirement.

Students who have completed three or more years of French, German, or Spanish in high school may not receive graded credit for 101-102 in those languages; test-out credit (T credit) may be obtained by passing an appropriate examination or by completing an advanced sequence (200-level or higher) in that language. If these students choose to take 101-102 on a remedial basis, they will be graded S-F.

Credits applied toward the foreign language requirement cannot be used to satisfy the general education requirements, but students who have fulfilled the foreign language requirement may apply additional courses in foreign languages toward the appropriate general education groups.

Majors in any foreign language are deemed to have fulfilled the college foreign language requirement. International students for whom English is a second language may satisfy the foreign language requirement by completion of Engl 104 and 105 at ISU with an average grade of C- or better. See Foreign Languages and Literatures for additional information on international students.

Advanced Credit Requirements

To obtain a baccalaureate degree from the College of Liberal Arts and Sciences, curriculum in liberal arts and sciences, a student must earn at least 45 credits at the 300 level or above taken at a four-year college. Three of the 45 credits must be earned in a group outside of the group of the major. Credits earned in electives taken on a pass/not pass basis or in the major or a minor may be used to meet this requirement.

Major

Students must complete the requirements of a major which will include 24 to 48 credits in the major discipline as specified by the major department or program. Tracks within a major must have a common 24 credit core. Some courses outside the major discipline may also be required as supporting work for the major. (See *Index* for page reference to individual department and program requirements.) The major must contain at least 8 credits in courses taken at Iowa State University that are numbered 300 or above and in which the student's grade is C or higher. In addition, the average grade of all courses in the major (those courses listed under major on the degree audit) must be 2.0 or higher. Courses in the department or discipline of the first major listed on the degree program may not be counted in the general education groups. Courses in general education may be counted in meeting the

requirements of additional majors. Students must check each additional major as some majors do not allow double majors with certain other majors.

The major shall be chosen from the following list, which also indicates the degree(s) offered in the respective majors.

Advertising, B.A.
Anthropology, B.A., B.S.
Biochemistry, B.S.
Biological/Pre-Medical Illustration, B.A.
Biology, B.S.
Biophysics, B.S.
Botany, B.S.
Chemistry, B.A., B.S.
Computer Science, B.S.
Earth Science, B.A., B.S.
Economics, B.A.*, B.S.
English, B.A., B.S.
Environmental Science, B.S.
Environmental Studies (may be taken as a second major with the degree to be determined by the first major)
French, B.A.
Genetics, B.S.
Geology, B.S.
German, B.A.
History, B.A., B.S.
Interdisciplinary Studies, B.A., B.S.
International Studies (may be taken as a second major with the degree to be determined by the first major)
Journalism and Mass Communication, B.A., B.S.
Linguistics, B.A.
Mathematics, B.S.
Meteorology, B.S.
Music, B.A., B. Mus.
Performing Arts, B.A.
Philosophy, B.A.
Physics, B.S.
Political Science, B.A.
Psychology, B.A., B.S.
Religious Studies, B.A.
Russian, B.A.
Sociology, B.A., B.S.
Spanish, B.A.
Speech Communication, B.A., B.S.
Statistics, B.S.
Women's Studies, B.A., B.S.
Zoology, B.S.

*Available only to students who were enrolled as majors before the 1995-1996 year. (See *Index, Economics*.)

The major in interdisciplinary studies (B.A., B.S.) is available for undergraduate students who have unique interdisciplinary educational goals. Such a major is designed by the faculty and the student and is approved only when the educational goals cannot be met by a reasonable combination of existing majors, minors, and electives. (See *Index, Interdisciplinary Studies*.)

Double Majors

Students may elect a second major from the departments and program areas listed above, or from a major field offered for the bachelor's degree in another college of the university. Double majors between the following are prohibited: Chemistry with Biochemistry and Agricultural Biochemistry; Biology with Animal

Ecology, Agricultural Biochemistry, Biochemistry, Botany, Genetics, Microbiology, and Zoology.

The major departments must then approve the degree program, and if those majors involve two colleges, both deans must approve. Such programs must fulfill the general education requirements of the college of the primary major. If one major leads to the B.A. degree and the other to the B.S. degree, the degree awarded will be the one offered by the department of the primary major. If the primary major may lead to either a B.A. or a B.S., a student may choose to receive either degree. In all cases, the student must satisfy the requirements of each major and of the degree that is chosen for the primary major. Majors from the Curriculum in Liberal Arts and Sciences may not be added to a Bachelor of Liberal Studies degree or a Bachelor of Music degree.

A student may earn two degrees in this curriculum with two appropriate majors and at least 30 additional credits. Either the B.A. or the B.S. in this curriculum may be earned with the bachelor of music. Any degree offered by this college may be earned together with a degree with a major in any other college of the university. For the requirements for two degrees, see *Index, Bachelor's Degree Requirements*.

Minor

A minor, which is optional, must consist of at least 15 credits, with at least 6 credits in courses numbered 300 and above taken at ISU with a grade of C or higher. (See *Index, Minors*.)

The following minors are offered by the college of Liberal Arts and Sciences:

Advertising
African American Studies
American Indian Studies
Anthropology
Astronomy
Biochemistry
Biological Illustration
Biology
Botany
Chemistry
Classical Studies
Criminal Justice Studies
Economics
English
Environmental Science
Environmental Studies
French
Genetics
Geology
German
History
International Studies
Journalism and Mass Communication
Latin
Linguistics
Mathematics
Meteorology
Music
Naval Science
Performing Arts
Philosophy
Physics
Political Science
Portuguese

Psychology
Religious Studies
Russian Studies
Sociology
Spanish
Speech Communication
Statistics
Technology and Social Change
Women's Studies
Zoology

Courses applied toward the general education groups may be used to meet the requirements of a minor. (For restrictions, see the *Index, Minors*.)

If a student declares a minor and completes the requirements specified by the offering department/program, the minor will be recorded on the transcript.

Electives

Students will take additional courses, freely elected, sufficient to accumulate a total of 124.5 credits. These additional courses together with the general education courses may be used to meet the requirements of a minor or of another major, provided that they are taken on a graded basis.

Planning the Program of Study

Careful, comprehensive planning is important for meeting graduation requirements and taking advantage of the resources offered by the university. Each student is encouraged to work with his or her academic adviser in developing a four year plan as soon as possible after declaration of the major. A degree audit listing all completed courses and those remaining to be taken for fulfillment of the degree requirements in the student's chosen major is provided to the student and the adviser each semester. The student should review the audit each semester and consult with the adviser when changes are required. Any changes to the audit must be approved by the academic adviser and by the dean's office. It is essential that the audit be reviewed and updated in a timely fashion in order to avoid delay in the student's graduation.

During the first year, students should meet proficiency requirements in English and in library. They should also make progress toward meeting the general education requirements, a large part of which should be completed by the end of the second year. The third and fourth years should emphasize completion of the major (and minor, if elected) and of general education requirements, and should give the student an opportunity to take electives.

The Open Option

Recognizing the fact that many students entering Iowa State University will not have selected a major, the College of Liberal Arts and Sciences provides the open option in order to give them time to explore possible majors and programs. Open option students who enter as freshmen are expected to declare a major by the beginning of the third semester of enrollment. Entering students who have completed three semesters in another school and students who wish to change majors but are not

yet ready to declare the new major may register under the open option for one semester, provided they have completed no more than 75 credits.

Program planning information is available through advisers of open option students, in departmental offices, and in the office of the dean of the College of Liberal Arts and Sciences. Early enrollment in certain course sequences is essential for students who are considering sciences or mathematical disciplines, and selection of a major field by the end of the first year is strongly recommended.

Honors Program

For information on the Honors Program in the College of Liberal Arts and Sciences, see *Index, Liberal Arts and Sciences, Cross-Disciplinary Programs, Honors Program*.

ROTC Programs

The College of Liberal Arts and Sciences also offers students the opportunity to combine their academic programs with ROTC programs in the Army, Navy, and Air Force.

Teacher Licensure

Students in the College of Liberal Arts and Sciences may be recommended for the Iowa Professional License for full-time teaching of certain subjects in secondary schools. For further information see *Index, Teacher Education Program*.

Preprofessional Programs

Students in the College of Liberal Arts and Sciences may participate in preprofessional programs in human health-related fields, law, and theology by taking the courses required for admission to professional schools. Students may enter the college with the designation Premed, Prelaw, or Preprofessional Health Programs. Most will earn a bachelor's degree by choosing a major and meeting the requirements for the major while taking the preprofessional courses. Others will spend one to three years as students in the college before transferring to a professional school to which they have applied and been accepted. For further information, see *Index, Preprofessional Study*.

Experiential Learning (Internship/Co-op) Program

The Experiential Learning (Internship/Co-op) Program assists students in gaining career-related experience while going to school. Internships/Co-ops provide students with the opportunity to gain specific skills, apply academic knowledge in practical situations, pretest their career choice, earn a salary, and establish a network of professional contacts.

Most internships are full-time and last for a semester or a summer, but a part-time experience is possible. Students wishing to receive academic credit for their internship must make arrangements with a faculty member in their major department. In contrast, co-op students work full-time on an extended basis (work two semesters) or on an alternating basis (work, school, work, etc.) during any semester (fall, spring, summer).

It may take students participating in the Experiential Learning (Internship/Co-op) Program an additional semester or more to
1999-2001

complete their academic curriculum requirements. For additional information, contact Business/Liberal Arts and Sciences Career Services.

Curriculum in Music

This curriculum leads to the degree bachelor of music and is an alternative to the curriculum in liberal arts and sciences with a major in music. To obtain a bachelor of music degree, a student must earn a minimum of 124.5 credits including a minimum of 32 credits in residence at Iowa State University and a minimum of 45 advanced credits (credits in courses numbered 300 or above) and must meet all of the requirements specified below. Courses taken on a pass/not pass basis may be counted toward the required total of 124.5 credits, and may be used to meet the advanced credit requirement, if appropriate, but may not be used to satisfy any other graduation requirement. No more than 9 credits in 490 (Independent Study) courses in a single discipline may be counted toward graduation. See *Music, Courses and Programs*.

Students interested in pursuing an emphasis in music theater should see the section on Theater, Performing Arts Major.

A minor in music is available; the requirements appear under Music, Courses and Programs.

Cr.	Degree Requirements
32	General Education Requirements (Students choosing the music education option should consult their advisers regarding general education requirements)
6	Social sciences
6	Humanities
6	Music 383, 384
9	Phys 198; mathematical, physical, and biological sciences
5	Electives
6.5-14.5	Other Requirements
6	Engl 104, 105†
0.5	Library 160
0-8	Foreign language (one)††
46	Music core
21	Music 120, 233, 234, 235, 236, 333, 334, 335, 336, 361
12	Music 119, 219, 319, 419
3	One of the following: Music 472, 473, 474, 475
3	One of the following: Music 430, 440, 448
7	Ensembles
34-38	Area of concentration (select one of the following options)
37-38	Music education* Licensure options:
37	(1) Vocal, K-6. (a) Music 248, 266, 366; C I 204, 406, 415; (b) LAS 417L; electives 3 credits**; (c) Music 327, 360, 362A, 357A, music theater 3 credits; music electives 2 credits.***

37	(1) Vocal, 7-12. (a) Music 248, 266, 366; C I 204, 406, 415; (b) LAS 417K; C I 426; (c) Music 327, 357A, 360, 362A, 367, 465, 466; music theater 3 credits.
38	(1) Instrumental K-6. (a) Music 248, 266, 366; C I 204, 406, 415; (b) LAS 417L, elective 3 credits;* (c) Music 350, 351, 352, 353, 354, 355, 356, 357B, 362B, 464, 466; music electives, 2 credits.***
38	(1) Instrumental, 7-12. (a) Music 248, 266, 366; C I 204, 406, 415; (b) LAS 417K; C I 426; (c) Music 350, 351, 352, 353, 354, 355, 356, 357B, 362B, 368 or 369, 464, 466.
34	Organ
4	Music 119B, 219B
8	Music 319C, 419C
8	Music 417, elective in advanced music history
3	Additional music theory
8	Additional foreign language
3	Electives
34	Piano
12	Music 119, 219, 319, 419
12	Music 321, 417
3	Additional music theory
7	Electives
34	String instruments
12	Music 119, 219, 319, 419
6	Music 181, 321
3	Additional music theory
4	Music 417
9	Electives
34	Composition
8	Applied music
4	Music 362A, 362B
13	Additional music theory and composition
9	Electives
34	Voice
4	Music 327 and 119B, 119C, or 119K
8	Music 319A, 419A
6	Music 324, 325, 360
3	Additional music theory
2	Music 417
8	Additional foreign language
3	Electives
34	Wind or percussion instrument
12	Music 119, 219, 319, 419
1-3	Music 351-352 or 353-354 or 355
3	Music 321
3	Additional music theory
4	Music 417
9-12	Electives
124.5-130.5	Total credits

†A student must earn an average grade of C- or better in Engl 104 and 105.

††The requirement may be met by completion of three or more years of high school study in one foreign language. Prospective students are encouraged to begin foreign language training as early as possible in their academic careers. Students who have a strong foreign language preparation may attempt to acquire college credit by taking a test-out examination which is administered each semester by the Department of Foreign Languages and Literatures.

*Because of overlapping requirements in the K-6 and the 7-12 licensure options (35 credits

each), students who complete both options will earn an actual total of 42 credits, including 16 weeks of student teaching. Those seeking only K-6 or 7-12 licensure will complete 12 weeks of student teaching. All students will complete at least 50 hours of field experiences, of which at least 40 hours must occur after admission to teacher education but before student teaching. Music education students should refer to the Teacher Education section of this catalog for further information. **Students pursuing both K-6 and 7-12 licensure should take C I 426. ***Students pursuing both K-6 and 7-12 licensure should take Music 367. ****Students pursuing both K-6 and 7-12 licensure should take Music 368 or 369.

Curriculum in Liberal Studies

The bachelor of liberal studies degree (B.L.S.) was established by the three Iowa Regent universities to meet the needs of lowans who want to earn a college degree but whose circumstances present obstacles to completing a traditional on-campus degree program. The degree may be earned from Iowa State University, the University of Iowa, or the University of Northern Iowa.

The B.L.S. is a general studies degree in the liberal arts. There is no traditional major. Instead, students take coursework in three areas of distribution. These areas may be focused in a single discipline or diversified over several disciplines. With the assistance of a B.L.S. adviser, students can structure a program that meets their individual educational, vocational or personal goals.

Up to three-fourths of the total degree requirements can be transferred from accredited institutions. Work done in community colleges or other accredited colleges and universities can be applied toward the degree, as can applicable courses taken at any of the three Iowa Regent universities, whether on or off campus.

The B.L.S. program has no residence requirements. To complete the degree, students may offer credits earned in various study formats: correspondence courses; telecourses; Saturday and evening courses; off-campus courses, including those with distance-learning formats; and regular on-campus courses. Students may also earn credits by proficiency or test-out examinations.

Admission

Admission to the B.L.S. program is open to persons who meet either of the following levels of previous educational attainment:

Hold the associate in arts (A.A.) or associate in science (A.S.) degree from an accredited two-year college. (Holders of the associate in applied science or associate in applied arts degree are not automatically eligible, although some courses may be found applicable upon review.)

Have at least 62 semester credits of collegiate work acceptable toward graduation at ISU with a total cumulative grade point average of at least 2.00 (a C average).

Requirements for the B.L.S. Degree

The B.L.S. candidate must earn a total of 124 credits in accordance with requirements listed below. Courses taken at Iowa State University on a pass/not pass basis may be counted toward graduation only as electives. No more than 9 credits of 490 (Independent Study) courses in a single discipline may be counted toward graduation.

Cr.	
48	General Education Requirements
6	Basic English composition
8	Foreign language*
12	Arts and humanities
2	Verbal communication
3	Mathematics, statistics, or computer science
8	Natural sciences
9	Social sciences from at least two different disciplines

A list of courses acceptable in the general education groups can be obtained from the college office.

36 Distribution Requirements

A minimum of 12 credits is required in each of three of the five distribution areas listed below.

Humanities (literature, philosophy, history, religion, art and music appreciation)

Communications and arts (journalism, speech, writing, drama, art, foreign language)

Natural sciences and mathematical disciplines (chemistry, physics, biology, geological and atmospheric sciences, mathematics, statistics, computer science)

Social sciences (sociology, psychology, economics, political science, anthropology, geography)

Professional fields (business, education, family and consumer sciences, social work, agriculture, engineering, nursing)

At least 24 upper-level credits are required in the three distribution areas with a minimum of 6 upper-level credits in each of the areas.

40	Electives
124	Total credits required for graduation

*The requirement may be met by completion of three or more years of high school study in one foreign language.

Other Requirements

Included in the total of 124 credits must be the following:

45 upper-level credits from a four-year college

32 credits from ISU earned during the junior/and or senior year.

Three credits of course work in U.S. Diversity and 3 credits in International Perspectives.

A grade average of at least 2.00 (a C average) in all coursework applied to the B.L.S. degree, in all upper-level coursework, and in all work completed after admission to the B.L.S. program.

Proficiency in English demonstrated by completion of an approved composition course from a four-year college or by faculty evaluation, as advised.



College of Veterinary Medicine

Richard F. Ross, Dean
Eldon K. Uhlenhopp, Associate Dean
Prem S. Paul, Associate Dean

Departments of the College

Biomedical Sciences
Veterinary Clinical Sciences
Veterinary Diagnostic and Production Animal Medicine
Veterinary Microbiology and Preventive Medicine
Veterinary Pathology

Other units of the college include the Veterinary Medical Research Institute, the Veterinary Medical Diagnostic Laboratory, the Veterinary Teaching Hospital, and Biomedical Communications. The college also participates in interdisciplinary majors in genetics, molecular cellular and developmental biology, toxicology, immunobiology, and neuroscience.

The instructional objective of the College of Veterinary Medicine is to enable students to assume vital roles in society as productive health care deliverers and biomedical scientists. Such an education provides students with general learning, communication, and problem solving abilities; veterinary medical practice and research skills; and professional and ethical values.

The curriculum incorporates basic biomedical and clinical principles, clinical decision making skills, and exceptional clinical experience in production medicine, food animal medicine and surgery, companion animal medicine and surgery, and equine medicine and surgery.

The college is uniquely qualified to provide education in veterinary medicine. Located in the heart of one of the world's most intensive livestock producing areas, the college provides diverse and extensive production animal medicine experiences and numerous diagnostic cases for study. A nearby metropolitan area and a regionally recognized referral hospital and community practice provide experience in companion animal and equine medicine and surgery.

The professional curriculum is a progressively integrated four-year course of study leading to the doctor of veterinary medicine degree. Students are admitted into the fall semester of the first year of the professional curriculum after completing a minimum of 60 semester credits in a preprofessional program. A strong and reputable basic science education during the first two years of the professional curriculum prepares veterinary students for a wide range of clinical experience during the last two years of the educational program. The students' education can be enhanced during the fourth year of the curriculum by participation in preceptorships in private practice, other colleges, research laboratories, industry, or government agencies. Outstanding research programs in neuroscience, immunobiology, infec-

tious diseases, and other areas provide opportunities for qualified students to participate in research.

A concurrent D.V.M./M.S., Ph.D. program is available for exceptionally qualified students who wish to obtain both veterinary and graduate degrees. Students must have a bachelor's degree or a minimum of 128 semester credits in preveterinary and professional curricula in order to participate in the concurrent degree program. Admission to the concurrent D.V.M./graduate degree program is subject to the approval of the dean of the College of Veterinary Medicine and the dean of the Graduate College.

The College of Veterinary Medicine is an important recruiting center for employers seeking veterinarians for private practice; industry; educational institutions; international agencies; federal, state and local governments; the armed forces; departments of public health; zoological gardens; laboratory animal medicine agencies; and other related fields of professional activity. Graduates are highly sought after and typically have multiple employment offers upon graduation. A career development office is available to help match students with appropriate employers.

Preveterinary Medicine Preparation

Admission Requirements

The College of Veterinary Medicine seeks students with diverse backgrounds and encourages students to enroll in baccalaureate programs in the college of their choice. Preveterinary students are strongly encouraged to complete a bachelor's degree before enrolling in the College of Veterinary Medicine. When deciding which major to pursue as an undergraduate, the preveterinary student should consider the area of veterinary medicine in which they intend to emphasize when they become a veterinarian. For example, those interested in food animal practice may wish to pursue a degree in biological science, animal science, agricultural economics, or business. Future companion animal practitioners may wish to consider a biological science, physical science, business, social science, or humanities degree. These examples are only suggestions. They should be considered as but a few of the numerous possibilities.

Applicants for admission to the College of Veterinary Medicine must have attended a regionally accredited college or university, have completed 40 semester credits prior to the deadline for filing an application for admission, and have completed 60 semester credits prior to the end of the spring term of the year in which the applicant seeks to be admitted to the College of Veterinary Medicine. It is strongly recommended that a majority of the requirements in biology, physics, general

chemistry and organic chemistry be completed by the time of application. Credits earned must include the following Iowa State semester course offerings or their equivalents:

English Composition (Engl 104 and 105)	6 sem cr.
(Sp Cm 212 or ComSt 214)	3 sem cr.
General Chemistry with Laboratory (Chem 177-177L, 178)	8 sem cr.
Organic Chemistry with Laboratory (Chem 331, 331L, 332)	7 sem cr.
Biochemistry (BBMB 301)	3 sem cr.
General Physics with Laboratory (Phys 111, 112)	8 sem cr.
Biology (Biol 201, 201L, 202, 202L)	8 sem cr.
Genetics (Biol 301)	3 sem cr.
Humanities or Social Sciences	9 sem cr.
Zoology (Zool 155)	3 sem cr.
Electives	2 sem cr.

Credits in the previously specified courses will normally be earned on the traditional four-letter grading system with A as the highest grade and D as the lowest passing grade. However, credits earned by the credit by examination program in accordance with the regulations relating to this procedure at Iowa State University are also acceptable. Credits in the preceding specified courses will not be accepted if earned under the pass-not pass grading system or similar options.

Application and Admission

Request for the professional curriculum application packet should be addressed to the Office of Admissions, 100 Alumni Hall, Iowa State University, Ames, Iowa 50011. Residents applying to multiple schools and non-residents may also apply through Veterinary Medical College Application Service (VMCAS). These applications may be obtained from the Association of American Veterinary Medical Colleges. Applicants with any international course work, including study abroad, must apply directly to Iowa State University. Completed applications and all supporting transcripts must be postmarked by October 1 of the year prior to the year in which the applicant seeks to be admitted.

All preveterinary requirements must be fulfilled by the time of filing or scheduled for completion by the end of Spring term of the year in which the applicant seeks to be admitted. A list of courses in progress at the time of filing or scheduled for completion by the end of spring term should accompany the application and transcripts. Preprofessional college credits must average at least 2.50 on a 4.00 marking system for the application to be accepted. The preceding scholastic requirements are minimum and do not assure admission even though these requirements have been fulfilled.

Admission to the College of Veterinary Medicine is on a competitive and selective basis. Scholastic performance in preprofessional courses, Graduate Record Examination scores (General), general achievement and experience related to veterinary medicine are given consideration in the selection of candidates.

The majority of the positions in the entering class are reserved for residents of Iowa. Two states, North Dakota (10) and South Dakota (6), have contracts for up to 16 students in each entering class. A similar contract is in place with the state of New Jersey for up to 4 positions. In addition, a number of positions are available to residents of other states. A few highly qualified international students may also be accepted. Consideration is given equally to all applicants without regard to race, color, national origin, gender, religion, disability, or age, political beliefs, or marital or familial status.

Curriculum in Veterinary Medicine

Leading to the degree doctor of veterinary medicine.

First Year

Cr.	Fall
5	Principles of Morphology I— B M S 330
3	Comparative Veterinary Physiology I—B M S 349
4	Microscopic Anatomy—B M S 332
3	Physiological Chemistry—BBMB 420
2	Case Study I—B M S 345
R	Professional Orientation—V Med 300
R	Seminar—V C S 385/VDPAM 385
17	

Cr.	Spring
4	Principles of Morphology II— B M S 331
5	Comparative Veterinary Physiology II—B M S 350
3	Neurobiology—B M S 337
2	Veterinary Immunology—V MPM 380
1	Radiology—V C S 391
2	General Pathology—V Pth 342
1	Case Study II—B M S 346
R	Seminar—V C S 385/VDPAM 385
18	

Second Year

Cr.	Fall
2	Ethical Issues in Veterinary Medicine—V Med 303
4	Veterinary Parasitology— V Pth 376
3	Systemic Pathology—V Pth 372
5	Veterinary Microbiology I—V MPM 386
2	Case Study III—V Pth 377
1	Integrative Physiology—B M S 355
R	Seminar—V C S 385/VDPAM 385
17	



Cr.	Spring
3	General Pharmacology— B M S 354
1	Anesthesiology—VCS 398
3	Veterinary Microbiology II— V MPM 387
3	Public Health—V MPM 388
6	Surgery—V C S 397/VDPAM 397
2	Case Study IV—V MPM 378
R	Seminar—V C S 385/VDPAM 385
18	
1	Electives—minimum accumulated

Third Year

Cr.	Fall
3	Clinical Pathology—V Pth 425
2	Infectious Diseases and Preventive Medicine—V MPM 436
5	Clinical Medicine I—V C S 444
3	Surgery Laboratory—V C S 449
4	Disturbances of Reproduction— V C S 450/VDPAM 450

3	Pharmacology and Therapeutics— B M S 443
R	Introduction to Clinics—V C S 440/VDPAM 440
R	Seminar—V C S 385/VDPAM 385
20	

Cr.	Spring
4	Special Pathology—V Pth 422
3	Infectious Diseases and Preventive Medicine—V MPM 437
5	Clinical Medicine II—V C S 445/VDPAM 445
3	Veterinary Toxicology—V Pth 426/VDPAM 426
2	Radiology—V C S 448
1	Ophthalmology—V C S 399
R	Seminar—V C S 385/VDPAM 385
18	
4	Electives—minimum accumulated

Fourth Year

The fourth year of the veterinary medical curriculum is designed to be flexible and to provide for species emphasis. Students must complete 38 credits during their fourth year. They must take a required block and at least one option block. The remainder of the fourth year credits are acquired by selecting additional option blocks, elective Veterinary Teaching Hospital clinical assignment, off-campus clinical electives, or other electives. Additional off-campus clinical elective credits can be earned through V C S 419/VDPAM 420 at approved agencies, research labs, veterinary practices, and other university hospitals. As many as 7 of the 38 credits required in the fourth year can be applied toward the general veterinary curriculum requirement of 11 elective credits.

Required Block

Cr.	
3	Anesthesiology—V C S 466
3	Radiology—V C S 460
1	Necropsy Laboratory—V Pth 456
1	Laboratory in Clinical Microbiology—V MPM 484
4	Intensive Care—V C S 468
1	Clinical Pathology—V C S 457
1	Laboratory in Public Health—V MPM 486
R	Seminar—V C S 495/VDPAM 495
14	

Small Animal Option Block

Cr.	
2	Small Animal Soft Tissue Surgery—V C S 455
2	Small Animal Orthopedic Surgery—V C S 456
2	Ophthalmology—V C S 469
2	Small Animal Medicine I—V C S 453
2	Small Animal Medicine II—V C S 454
2	Community Practice—V C S 463
12	

Food Animal Option Block

Cr.	
4	Production Animal Medicine and Service—VDPAM 411
2	Diagnostic Laboratory Practicum—VDPAM 455
6	

Production Animal Medicine Block

Cr.	
4	Production Animal Medicine—VDPAM 411
2	Diagnostic Laboratory Practicum—VDPAM 455
6	Species Emphasis Courses (minimum of 6 credits required)
2-6	Swine Production Medicine Series—VDPAM 478, 479, 480
2-6	Beef Production Medicine Series—VDPAM 481, 482, 483
2-4	Introduction to Dairy Production Medicine—VDPAM 484, 485
2-4	Introduction to Small Ruminant Production Medicine—VDPAM 486
12	

Equine Option Block

Cr.	
3	Equine Medicine—V C S 457
3	Equine Surgery—V C S 458
6	
38	Required
11	Electives—minimum accumulated

Graduation Requirements

To be awarded the degree doctor of veterinary medicine, candidates must have passed all required courses in the curriculum in veterinary medicine, have earned at least 11 elective credits on a graded basis of A, B, C, D while enrolled in the College of Veterinary Medicine, have at least a 2.0 grade-point average in the veterinary medicine curriculum, and have passed the prescribed comprehensive examinations during the third and fourth years.

Reinstatement

Any student who voluntarily withdraws from the College of Veterinary Medicine or who is dropped for cause, after having successfully completed one or more semesters forfeits his/her standing and must make written application for reinstatement to this college 45 or more days prior to the opening of the semester for which they seek to re-enter. Any student who voluntarily withdraws from the College of Veterinary Medicine prior to completion of one semester must re-apply for admission to the college in the general applicant pool.

Veterinary Medical Societies

All veterinary students are encouraged to become active members of the Iowa State Student Chapter of the American Veterinary Medical Association. The monthly meetings of the chapter serve to promote the professional development of the members. Students of veterinary medicine may also qualify for membership in the national honor societies of Phi Zeta, Phi Kappa Phi, Alpha Zeta, and Gamma Sigma Delta. Graduate students may qualify for membership in Sigma Xi.



Graduate College

Patricia B. Swan, Dean
John M. Dobson, Associate Dean
George A. Jackson, Assistant Dean
Patricia M. Keith, Assistant Dean
John E. Mayfield, Associate Dean

The Graduate College and graduate faculty at Iowa State University are responsible for the quality of graduate education, for supervising students' graduate programs, and for obtaining research support from various governmental, industrial, and private agencies.

The graduate faculty in various programs handle admission and classification of graduate students, establish requirements for advanced degrees, and have charge of instruction and research at the graduate level. Graduate faculty members also teach graduate courses, serve on program of study (POS) committees, and direct work of master's and doctoral students. All graduate courses offered for major or nonmajor credit are taught by graduate faculty members or graduate lecturers.

Graduate study was offered soon after the university was founded, and the first graduate degree was conferred in 1877. Experimentation and research also started early, first in agriculture and shortly thereafter in home economics, engineering, science, and veterinary medicine. In 1913, the graduate faculty was organized formally and an executive graduate committee was appointed. In 1915, the graduate faculty held its first meeting, and in 1916, it granted the first doctor of philosophy degree.

Graduate education is vital to the quality of university teaching. The creative efforts of graduate faculty members and graduate students result in knowledge necessary to help society solve problems in educational, scientific, technological, and socio-economic areas. The Graduate College encourages educational exchange and contact with undergraduate areas of the university to promote improved teaching on both the undergraduate and graduate levels. A part of this exchange is accomplished by the publication of books and technical articles which are made possible by graduate research.

The degrees master of arts, master of science, and doctor of philosophy are research oriented. In many fields master's degrees are also awarded without a thesis, but a written report of independent study, called a creative component, is generally required. For those individuals interested in advanced study directed toward meeting vocational or professional objectives, the following degrees are offered: master of agriculture, master of architecture, master of business administration, master of community and regional planning, master of education, master of engineering, master of family and consumer sciences, master of fine arts, master of landscape architecture, master of public administration, master of school

mathematics, and the specialist degree in school psychology.

The Graduate College Handbook lists policies and procedures of the Graduate College. It is available in the Graduate College, in program offices, and at the Graduate College's Web site: www.grad-college.iastate.edu/. Each new graduate student is urged to obtain a copy. It is mailed to graduate faculty members. Most of the forms in this bulletin are also available online at www.grad-college.iastate.edu

Graduate Appointments

Graduate assistantships, fellowships, and research grants have been established at Iowa State University to encourage graduate work and to promote research. Such appointments and research opportunities are available through the various departments of instruction and the research centers on campus.

Graduate assistantships, the most common form of graduate student support, are available in three categories: the research assistantship, the teaching assistantship, or the administrative assistantship. A half-time graduate assistantship permits the holder to enroll for a maximum of 12 semester credits. Recipients of these assistantships are assessed fees at full Iowa resident rates regardless of the number of credits for which they register. Students who are graduates of a regionally accredited college or university in the United States or of a recognized institution in another country whose requirements for the bachelor's degree are substantially equivalent to those of Iowa State University, who graduated in the top half of their respective classes and who present the requisite undergraduate or graduate preparation, may apply for these appointments. Students registered on a restricted basis or those placed on academic probation are eligible for assistantship appointment only on a term by term basis. Students admitted without a declared major are not eligible for assistantship appointments. Further information may be obtained by writing to the appropriate graduate program.

The satisfactory completion of one appointment, plus satisfactory academic performance, will ordinarily make a student eligible for reappointment. After a period of three years of full time study for the master's degree or five years for the doctorate, the student will not normally be continued on assistantship support (shorter periods may be stipulated by the student's program or department).

Postdoctoral Study

Opportunities are provided for postdoctoral study through the extensive research programs of the university. Inquiries should be directed to the appropriate program, institute, or to the dean of the Graduate College.

Graduate Study by Staff Members

Any full-time member of the research, instructional, or extension staff at the rank of instructor, research associate, or assistant scientist may carry up to six course credits per semester and three credits per summer session, subject to the approval of the head of the program or section, and provided it does not interfere with other duties. This privilege may be extended to members of the research, instructional, or extension staffs at the rank of assistant professor with approval of the college dean and the Dean of the Graduate College. Staff members at the rank of professor or associate professor cannot become candidates for graduate degrees from ISU.

Admission

Admission to the Graduate College may be granted to a graduate of an institution in the United States that is accredited by a recognized regional association or to a graduate of a recognized institution in another country whose requirements for the bachelor's degree are substantially equivalent to those of Iowa State University. For information concerning graduate study in a particular academic discipline, prospective students should correspond with the chair of the major program in which they wish to study.

Application forms, available from the Office of Admissions, should be completed and returned to 100 Alumni Hall with a \$20 application fee (\$50 for international applicants) by June 15 for fall, November 15 for spring, and March 15 for summer, prior to the term for which admission is sought. (International applicants should apply at least six months before the term in which they wish to enter.) Because many programs have earlier admission deadlines, the applicant should check with the appropriate program for this information. The application fee is required of all applicants except those who have attended Iowa State as undergraduates, or those applying for admission in the nondegree admission status. In addition, an applicant must request that each previous college or university attended send official transcripts of grades and credits earned, and request that the institution from which the degree was granted provide a statement of the degree received and the applicant's quartile class rank.

Categories of Graduate Admission

An applicant pursuing an advanced degree must be recommended by the program in which he/she will be pursuing an advanced degree and must be approved by the Dean of the Graduate College.

There are three admission categories for students who wish to pursue an advanced degree:

Full Admission status may be granted to students who meet either of the following requirements:

1. Graduate in the upper one-half of the graduating class with a bachelor's degree from a regionally accredited U.S. institution; or
2. Graduate in the upper one-half of the graduating class from a recognized foreign institution where the requirements for the bachelor's degree are similar to those at Iowa State.

Provisional admission status may be granted to students who meet the requirements for full admission (listed above), but have academic or prerequisite deficiencies to remedy. Transfer from provisional admission to full admission status requires the completion of the graduate English requirement, completion of the coursework prescribed to remedy the background deficiencies with a grade average of B or better, and the written recommendation of the major professor and approval by the dean of the Graduate College.

Restricted admission status may be granted to students who do not rank in the upper one-half of their graduating class and/or lack adequate undergraduate preparation in the proposed field of study. Restricted admission may be granted to graduates of non-English-speaking foreign institutions, even though the student ranks in the upper one-half of the graduating class. Advancement from restricted to full admission status requires completion of 9 semester credits of graduate level coursework as a graduate student with a cumulative grade average of B or better and satisfaction of the Graduate College English requirement. The recommendation is submitted in writing by the major professor and must be approved by the Dean of the Graduate College.

Graduate Admission Without a Declared Major

Admission without a declared major is a category for graduates of regionally accredited institutions in the United States who do not intend to seek an advanced degree from Iowa State University. Such students usually include:

1. Those who intend to transfer graduate credit earned at Iowa State University to other institutions.
2. Those who intend to use graduate credits earned for professional certification.
3. Those who enroll for personal satisfaction.
4. Those who enroll occasionally in off-campus graduate courses.

Students who wish to apply to Iowa State University without a declared major need to contact the Office of Admissions, 100 Alumni Hall (1-800-262-3810) for the nondegree application form for students in this category.

Applications and schedules for such students with an undeclared major are processed directly by the Office of Admissions and the Graduate College office; no program approvals are required. (Applications and schedules for students declaring a major require program evaluation and approval.)

A student without a declared major who sub-

sequently seeks full, provisional, or restricted admission must apply to and be accepted by a graduate program and by the Graduate College for degree study. A new application, the application fee (unless the student attended Iowa State University as an undergraduate), and transcripts from all colleges attended are required.

For those students originally admitted to the Graduate College on a nondegree basis, no more than 9 semester hours of graduate credit earned under the nondegree option may be applied if the student later chooses to undertake a graduate degree program. The student's program of study committee will recommend to the Graduate College which courses (if any) taken on a nondegree basis may be included in the degree program.

Graduate Admission of International Students

An applicant who is a graduate of a recognized foreign institution is subject to the same criteria for admission as a graduate from an institution in the United States and may be recommended for the same admission categories described above except that of the nondegree option. International applicants for nondegree status may be considered for admission at the discretion of the Graduate College dean. Application and admission deadlines for international students can be obtained from the publication Information for International Graduate Applicants.

International students are required to show evidence of financial support and to carry adequate health and accident insurance while in residence.

Admission Examinations

Graduate Record Examination. The Graduate Record Examination (GRE) is not a university-wide requirement for all applicants. However, many programs require or recommend submission of GRE scores; individual program statements appearing in the publication Graduate Admissions Bulletin should be consulted for this information.

English Requirement for Native Speakers

The English requirement for native speakers is fulfilled by passing the Graduate English Examination, a test of English grammar, usage, spelling, and punctuation. Performance on that test will determine whether a student must take an additional writing proficiency test.

Students (except those admitted on a nondegree) should satisfy the Graduate College English requirement before completing 12 credit hours of graduate work at Iowa State University.

English Requirements for Non-native Speakers

Applicants whose native language is not English and who have not earned a bachelor's or master's in a country where the only official language is English are required to submit Test of English as a Foreign Language (TOEFL) scores as part of their application for admission. A minimum score of 500 on the paper-based TOEFL (or at least 173 on the computer-

based test) is required for admission to the Graduate College. Because some programs require a higher score, applicants should check directly with the program to which they desire admission or see the bulletin Information for International Graduate Applicants for this information.

Graduate students whose native language is not English and who do not have an undergraduate degree from Iowa State University must also take the English Placement Test at the beginning of their first semester of enrollment. This test is administered by the Department of English in lieu of the Graduate English Examination. Students who do not pass this examination are assigned to one or more courses in the English 101 series. This coursework must be completed during the first year of study.

Graduate students whose native language is not English, but who have an undergraduate degree from Iowa State University, must take the Graduate English Examination for International Students, also administered by the Department of English, at the beginning of their first semester of graduate work. Students who do not pass this examination must complete English 101D during their first year of study.

New teaching assistants whose native language is not English are evaluated for their ability to communicate effectively in English before their assistantship assignments are made. Tests of oral proficiency and teaching skills (SPEAK and TEACH) are given before the beginning of each semester. A prospective teaching assistant who does not pass is required to complete coursework in speaking and teaching skills and must be retested.

Registration

Graduate students are encouraged to register for courses through the Touch-tone Registration System. Students who are unable or who choose not to register through this system may use a walk-through registration procedure. Students who do not register by the published deadline for initiation of a schedule through the touch-tone system must use the walk-through procedure, which differs from the touch-tone procedure in only one important way—for walk-through registration the approved Touch-tone Registration Worksheet must be presented to the Student Scheduling Office, 10 Alumni Hall, where the schedule will be entered on a terminal. New graduate students should report to their program offices for assistance in completing the ISU Touch-tone Registration Worksheet. For complete information on registration, see the ISU Schedule of Classes.

Credit Limits. Registration is limited to a maximum of 15 credits per semester. Schedules for graduate assistants on one-half time appointments are limited to a maximum of 12 credits. For full-time staff members, the limit is 6 credits. (Different credit limits apply during the summer session; see the *Graduate College Handbook* for more details.)

Correspondence Courses. ISU does not offer correspondence work nor is it accepted as transfer credit.

Interim Registration. Registration for special work between semesters and during certain vacation periods cannot exceed one credit for each week that the student is in residence.

“In Absentia” Registration. Students completing research or thesis preparation may register in absentia; these credits do not apply toward residence requirements.

Extension and Off-campus Registration. Many programs offer off-campus classes taught by members of the graduate faculty. Special arrangements are made for the necessary library and laboratory resources so that these classes correspond to those taught on campus.

Continuous Registration. Even when Ph.D. graduate students have completed course work and residence requirements, they are required to register and pay fees whether or not university facilities and equipment are used or staff consulted—either in person or in absentia

After the preliminary oral examination is taken and if university facilities, equipment, and staff time are used, the Ph.D. candidate must register for the appropriate number of credits in the major department or program and pay the appropriate graduate tuition and fees.

After the preliminary oral examination is taken and if university facilities, equipment, and staff time are not used, the Ph.D. candidate may register for a minimum of Gr St 680 (Continuous Registration) and pay the Continuous Registration fee.

The Ph.D. candidate must be aware that registration for a minimum of Gr St 680 is allowed only after the Ph.D. candidate passes the preliminary oral examination, is required only in fall and spring semesters, is not allowed after the completion of the final oral examination, and is not sufficient registration for the terms of the preliminary or final oral examinations.

If students take the final examination during the interim between terms (including the first day of classes), registration can be for the term either before or after the examination is held.

Auditing. Audit registration means taking courses without receiving formal credit. An agreement to audit a 500 or 600 level course must be negotiated between the student and the course instructor. An audited course counts for only one credit in the graduate student's allowable course load; however, fees will be assessed for the full number of credits for the course. Audited courses do not appear on the student's permanent record unless the “Request for Audit(s) to Appear on Transcript” form is completed and signed by the student, course instructor, and major professor. Copies of this form, which are available from the Graduate College, must be filed with the Graduate College, 207 Beardshear Hall. After the fifth class day, if a student changes a regular course to an audit, that course will appear on the student's permanent record as a drop.

Graduate Courses Taken by Seniors. Certain graduate level courses listed in the ISU General Catalog may be used in the program of study even though they were taken for

graduate credit by the student as an undergraduate senior at ISU. The following conditions must be met: the POS committee can request approval from the Dean of the Graduate College that up to nine hours of such credit to be applied toward meeting advanced degree requirements (these courses must be clearly marked on the POS); credits earned in these courses must be in addition to those used to meet requirements for the bachelor's degree and must have grades of B or better; the student must be classified as an undergraduate senior and not a special student (credits taken as a special student are not allowed); a letter of certification must be obtained from the Graduation Office (10A Alumni Hall) indicating that the courses were not taken as a special student and were not used toward fulfillment of the undergraduate degree program. This letter must be submitted with the POS form.

Admission of Undergraduates to Concurrent Graduate Degree Programs.

Programs in seven departments (Agricultural and Biosystems Engineering, Biochemistry and Biophysics, Civil and Construction Engineering, Food Science and Human Nutrition, Materials Science and Engineering, Psychology, and Zoology and Genetics) provide opportunities for well qualified ISU juniors and seniors majoring in those curricula to apply for admission to programs leading to both an M.S. and a B.S. awarded usually at the end of a fifth year of study. Students interested in a research career may apply for graduate research assistantships during their fourth and fifth years of study. Students should contact the above departments about applying to these concurrent programs. A student may individually design a concurrent undergraduate/graduate degree program in other areas by applying directly to the adviser and in the Graduate College. Official enrollment and fee payment will be as a graduate student. Credits transferred from the graduate permanent record to the undergraduate permanent record are no longer available for use on a graduate program of study.

Students in Veterinary Medicine and Concurrent Graduate Programs. Advanced students in veterinary medicine may request permission from the Dean of the College of Veterinary Medicine and the Dean of the Graduate College to pursue work concurrently toward the degrees master of science or doctor of philosophy and doctor of veterinary medicine. To participate in such a concurrent program, a student must be admitted to the Graduate College and a program of study committee must be appointed according to the usual procedures. A concurrent enrollment request form should be obtained from the Office of Admissions and circulated for the appropriate approvals. The program of study must be approved by both the Graduate College and the College of Veterinary Medicine. (Please see the *Graduate College Handbook* for more information.)

Admission of Graduate Students to Concurrent Undergraduate Programs. Graduate students interested in enrolling in a concurrent undergraduate program should contact the Office of Admissions (100 Alumni Hall)

to obtain admission information (even if the student has been previously admitted as an undergraduate). A “Concurrent Enrollment Request” form should be obtained from the Office of Admissions and circulated for the appropriate approvals. The student must be formally admitted both as a graduate student and as an undergraduate student. Official enrollment and fee payment will be as a graduate student. Credits transferred from the graduate permanent record to the undergraduate permanent record are no longer available for use on a graduate program of study.

Courses Taken as a Special Student.

Courses taken by a person with special student admission status may not be used in a graduate degree program. Persons with a baccalaureate degree are required to register as graduate students if they take graduate credit courses.

Grading

Grade Point Average (GPA). The GPA is determined by dividing the number of grade points earned by the total number of ISU cumulative hours. The grade given when an incomplete (I) is resolved is figured into the cumulative grade point average, not into a particular semester's average. Marks of I, S, P, NP, T, and X are not counted in the grade point average; a mark of F (even if taken S/F) is counted in the grade point average. Creative Component/Research (599 and 699) credits are not used in the calculation of the GPA. In the case of repeated courses, only the grade achieved the last time the course is taken is used in computing the grade point average.

Grading Research and Creative Component Credits. Creative Component/Research credits may be graded as A, B, C, D, I, S, or F. Plus and minus grades are optional. These credits are not calculated in a student's GPA.

Pass (P)/Not Pass (NP) Course Credit.

Pass/Not Pass courses are those that a student, with the approval of the major professor, may take for personal enrichment, but not for making up satisfying prerequisites or deficiencies in undergraduate background. Examples of personal enrichment courses might include courses in physical education, art, and music. P/NP marks may not be used in a POS, nor do P/NP marks contribute to the student's GPA. The full credit for P/NP courses is used in calculating tuition assessment and credit load limitations.

Satisfactory/Fail (S/F) Grading. S/F grading is not the same as P/NP grading. S/F grading is by instructor option; all students in a particular course receive S/F grading. P/NP grading is generally a student option. A P mark is equivalent to at least a D- grade whereas an S mark is equivalent to at least a B grade at the graduate level. No special registration procedures are required for S/F grading. An S mark in a course taken S/F is not counted in the grade point average, but an F mark in a course taken S/F is counted in the grade point average and is equivalent to an F in a regularly graded (A-F) course. No more than 20 percent of the total credits (excluding creative component, thesis or dissertation research) in the program of study may be earned on an S/F basis.

S/F grading may be used only for approved courses offered as seminars, symposia, workshops, special topics, and research. Programs must submit requests for S/F grading to the Dean of the Graduate College. The Graduate College Curriculum and Catalog Committee reviews and approves or rejects all requests for S/F courses.

Grievances about Grades. A graduate student who feels that a course grade has been unjustly assigned, and whose attempts to resolve the matter with the instructor have failed, may appeal through the grievance procedures described in the *Graduate College Handbook*.

Probation. If a graduate student does not maintain a cumulative 3.0 grade point average on all course work taken, exclusive of research credit, he or she may be placed on academic probation by the Dean of the Graduate College. Grades earned by graduate students in undergraduate courses are included in the calculation of the grade point average. Academic probation judgments are made on the basis of grades in course work only.

While on academic probation a student will not be admitted to candidacy for a degree and if appointed to a graduate assistantship, the student will not receive a Graduate College tuition scholarship.

To insure that registration does not take place without a review by the program, the Graduate College places a hold on future registrations by the student on probation. Before the student registers for each term, the program must review his or her record and recommend whether the Graduate College should continue to permit registration. Some programs conduct reviews by their entire graduate faculty; others assign the responsibility to POS committees. Before graduation is approved, the student must complete all courses listed on the program of study with a minimum grade of C and have achieved a 3.0 GPA or greater. Exceptions must be recommended in writing by the student's POS committee and DOGE and approved by the Dean of the Graduate College.

Master's Degrees

General requirements for all master's degrees are as follows:

Appointment of the Student's Program of Study (POS) Committee. Faculty in a major field have the responsibility for establishing specific course requirements and research requirements appropriate to the master's programs in the major. These requirements may place additional responsibilities on the student, the major professor, or the student's POS committee beyond those listed in this bulletin as deemed appropriate to the goals of the major program.

This committee consists of at least three members of the graduate faculty. It must include two members, including the major professor, from inside the major. The committee must include members from different majors or different departments so as to ensure diversity of perspectives. A term member of the graduate faculty may participate in the direction of a student's master's research as a co-

major professor if a member of the graduate faculty serves as a co-major professor and jointly accepts responsibility for the direction of a program of study.

Program of Study. The student and major professor develop the program of study with the consultation and approval of the POS committee. This agreement between the student and the Graduate College should be submitted as early as possible for approval. It is recommended that the committee be formed and the POS form submitted as early as the second semester of graduate study but no later than the term before the final oral examination.

Residence. There is no on-campus residence requirement for the master's degree.

Credits. Unless otherwise noted, at least 30 credits of acceptable graduate work must be completed in all master's programs. At least 22 graduate credits must be earned from Iowa State University.

Transfer Credits. At the discretion of the POS committee, and with the approval of the program and the Graduate College, graduate credits earned as a graduate student at another institution may be transferred if the grade was B or better. Transfer credits are normally considered only for graduate course offerings of the college or university that the student attended. Such courses must have been acceptable toward an advanced degree at that institution and must have been taught by individuals having faculty status at the institution. If a student wishes to transfer credits from graduate courses taken at another university as an undergraduate student, it is the student's responsibility to provide verification by letter from that institution that these graduate courses were not taken to satisfy undergraduate requirements for a degree.

Research credits earned at another institution are generally not transferred. In rare circumstances, the transfer of S or P marks may be accepted for research credits only. It is the responsibility of the POS committee to obtain a letter from the responsible faculty member at the other institution stating that research credits recommended for transfer with S or P marks are considered to be worthy of a B grade or better.

Major. The exact number of credits in a major is not prescribed. To obtain the specialization which is considered essential for an advanced degree, approximately two-thirds of the work should be devoted to the major field, but this is not necessarily restricted to one program.

Minor. Requirements for declared minors are determined by the minor program and the faculty member representing the minor field on the student's POS committee. The minor subject area must be tested at the final oral examination and cannot be placed on the transcript after graduation unless it was approved on the program of study, listed on all examination reports, and recorded on the "Application for Graduation" form (diploma slip).

Department/Program Change. To change from one or program to another, a graduate student must obtain the written permission of the director of graduate education (DOGE) and

the approval of the Dean of the Graduate College. A "Request to Transfer From One Program to Another" form must be completed. This form is available from the department, the Graduate College office, or on its web site at www.grad-college.iastate.edu

Time Limits. It is expected that work for the master's degree shall be completed within five years. In special circumstances the student's POS committee may recommend that the Dean of the Graduate College extend these degree time limits. Cases in which the student leaves Iowa State during his or her graduate career and later returns are dealt with individually by the student's POS committee and the Graduate College. The inclusion in the program of student of course work that is beyond the time limits ("over-age" courses) must be justified by the POS committee in a statement accompanying the submission of the program of study.

Application for Graduation. Students planning for graduation must submit an "Application for Graduation" form (diploma slip) to the Graduate Office by the end of the first week of the semester (fall or spring) in which he/she expects to receive the degree, or by the last day of spring semester if summer session is the desired graduation term.

Before submitting this form, a student must have submitted and had approved by the Graduate College a "Recommendation for Committee Appointment" form and a "Program of Study" form. Also the student must have been fully admitted to a program and have met the Graduate English requirement. Graduation may be delayed if the "Application for Graduation" form filing deadline is not met. If it becomes apparent that a student cannot graduate during the indicated term, he/she should call the Graduate College (515-294-4531) and cancel the previously submitted "Application for Graduation" form. The student must then file a new form for the next planned term of graduation.

Thesis. A thesis is required in all areas in which the master's degree is granted, except where specific provision is made for a nonthesis degree program. The minimum credit requirement for thesis research is three credits.

The student should consult *The Graduate College Thesis Manual* for instructions about thesis format preparation and time schedules. Copies are available at the Thesis Office, 203 Beardshear, the Graduate College, 207 Beardshear, and on the Graduate College web page at www.grad-college.iastate.edu. Joint authorship is not permitted. A complete, unbound copy of the thesis must be submitted to the Thesis Office for a format check by the first submission deadline of the semester in which the student intends to graduate or before the request for a final oral examination form is filed, whichever comes first. Copies of the completed thesis must be in the hands of the POS committee at least two weeks before the final examination. After the final examination and at least two weeks before graduation, the appropriate number of unbound, signed copies of the thesis must be submitted to the Thesis Office, 203 Beardshear Hall. A thesis

processing fee is charged during the term in which the student intends to graduate.

Creative Component. Every nonthesis student must present substantial evidence of individual accomplishment (e.g., a special report, capstone course, integrated field experience, annotated bibliography, research project, design, or other creative endeavor). A minimum of two credits of such independent work is required on every program of study for a nonthesis master's degree. Some programs require more credits. (For more information, contact the individual program.) The element of creative independent study must be explicitly identified on the program of study. As with a thesis, a creative component should be submitted to members of the POS committee two weeks before the final oral examination.

Final Oral Examination. The final oral examination must be held by the final examination deadline date for the semester in which the degree is granted. All coursework in the program of study must either be completed or in progress before the final examination can be scheduled. This examination is oral; it may also include a written component if specified by the student's (POS) committee. For more detailed information, see the *Graduate College Handbook*.

Graduate students must register for the equivalent of two credits, or for the R-credit course GR ST 600 (Examination Only) if no course work is needed, during the semester in which the final examination is taken. If the examination is taken during the interim between terms (including the first day of classes), registration can be for the term either before or after the examination is held.

Graduate Student Approval Slip for Graduation. Every candidate for an advanced degree is required to complete a "Graduate Student Approval Slip for Graduation" form. It is sent to the major professor or program to give to the student after the "Request for Final Examination" form is received and approved by the Graduate College. Signatures are required by the major program, the Thesis Office (for those completing a thesis), and the Graduate College. Final clearance of academic requirements will be made when current term grades have been submitted and evaluated by the Graduate College.

All incompletes from previous terms must be completed by the deadline for completion of the Graduate Student Approval Slip. If a conditional pass was recommended at the final oral examination, the major professor and the committee members, if so specified, must notify the Graduate College in writing no later than the due date for the Graduate Student Approval Slip for the term of graduation that the conditions have been met.

Specific Master's Degrees

The number of credits in a major for a master's degree will vary according to the degrees listed below. General credit requirements for all master's degrees include: a minimum of 30 graduate credits is required for all master's programs at ISU; at least 22 graduate credits must be earned at ISU unless noted in descrip-

tions; to obtain the specialization that is considered essential for an advanced degree, approximately two-thirds of the work should be devoted to the major field, but this is not necessarily restricted to one program; any transfer of graduate credits from another institution must be recommended in the program of study by the POS committee; and graduate credit earned as a graduate student will be approved for transfer only if a B grade or better was earned.

Master of Arts or Master of Science—Thesis.

At least 30 credits of acceptable graduate work must be completed, not less than 22 of which must be earned from ISU. Students are expected to research and write a thesis that demonstrates independent and creative work. A minimum of 3 semester credits is required for thesis research.

Master of Arts or Master of Science—Nonthesis.

In certain programs a nonthesis degree program is offered. (For more information on requirements, contact the individual program or department.) This option requires the satisfactory completion of at least 30 graduate credit hours of acceptable work (not including research credit) and satisfactory completion of a comprehensive final oral examination. In addition, every nonthesis master's program must present substantial evidence of individual accomplishment (e.g., a special report, capstone course, integrated field experience, annotated bibliography, or other creative endeavor). A minimum of two semester hours of such independent work (referred to as the creative component) is required on every program of study for a nonthesis master's degree and is applied toward the credit-hour requirement. This element of creative independent study must be explicitly identified on the program of study. Detailed requirements may vary with fields. Reference should be made to the *Courses and Programs* section in this catalog.

Master of Agriculture. The major in professional agriculture is an off-campus, nonthesis program leading to the master of agriculture degree. It is available to students wishing to pursue graduate study in agriculture without taking formal coursework on campus. The program is considered to be a terminal master's degree. Students are required to take a minimum of two courses in each of three disciplines and complete 24 semester credits of formal coursework. In addition, a minimum of four credits of creative component experience and four credits of workshops are required, resulting in a total of 32 graduate credits of coursework. Courses are offered in agricultural mechanization, agronomy, animal science, horticulture, and economics.

Master of Architecture. The Department of Architecture offers a two-part program leading to the master of architecture, a professional degree. Beyond the bachelor of architecture degree, a minimum of 30 graduate credits is required. Beyond the B.A. or B.S. degrees in architecture or environmental design, a minimum of 60 credits is required. For students with other baccalaureate degrees, a program of more than 100 credits may be tailored to each student's experience, training, and edu-

cation. For programs of 60 credits or more, 40 must be graduate credits.

Master of Business Administration. The College of Business offers a 48 graduate credit-hour program leading to a nonthesis master of business administration degree. Students may select courses in the traditional business disciplines or choose areas of specialization in agribusiness, accounting, finance, information systems, marketing, and manufacturing and quality. An advanced entry option may be available to those students with appropriate preparation in undergraduate business courses. Up to 18 credit-hours may be waived by the program if a student is accepted under this option.

Since no final oral examination is required, M.B.A. students must be registered for the equivalent of 2 credits the term of graduation or Gr St 601 (required registration) if no course work is required.

Master of Community and Regional Planning. The master of community and regional planning degree requires a minimum of 48 graduate semester credit hours. This degree is available as a thesis or nonthesis option.

Master of Education. For the master of education degree, a range of 30 to 40 credits of graduate-credits are required. The student demonstrates an ability to perform independent study through the completion of a creative component or a field-based activity.

Master of Engineering. The academic standards and the general level of attainment are the same for the master of engineering and master of science degrees. Master of engineering programs are offered to meet the needs for professionally oriented programs on campus and for off-campus professionally oriented programs at locations with adequate library and laboratory facilities. An appropriate number of credit hours in design, laboratory work, computation, or independent study is required as evidence of individual accomplishment.

Master of Family and Consumer Sciences. The College of Family and Consumer Sciences offers two nonthesis options leading to the degree master of family and consumer sciences. Both options are designed to enhance the skills of those holding the bachelor's degree so that they may meet the requirements of their present jobs or progress in their careers. The comprehensive option can be followed on or off-campus and requires 36 graduate credits covering a variety of family and consumer sciences subject matter. The specialization option requires 36 credits and is offered on-campus from the following departments: Hotel, Restaurant, and Institution Management; Human Development and Family Studies; and Textiles and Clothing. Both options require a written and oral integrative final exam.

Master of Fine Arts. For this degree a minimum of 60 graduate credits is required, including the completion of a thesis-exhibition or a thesis.

Master of Landscape Architecture. The master of landscape architecture degree requires a minimum of 36 graduate credits and the satisfactory completion of a thesis or a creative component.

Master of Public Administration. This is a professional degree program designed to provide training necessary for an administrator in a public or quasi-public bureaucracy. A minimum of 39 graduate credit hours is required, including internship and creative component opportunities.

Master of School Mathematics. This degree is designed primarily for inservice secondary mathematics teachers. Its prescribed program of study requires 36 graduate credits, two of which come from the writing of an approved creative component, 15 from courses offered for graduate credit, and 13 from courses offered for nonmajor graduate credit.

Master of Systems Engineering. This program is broadly based and uses courses in the various departments of the College of Engineering and courses in other departments of the university. The 30 credits necessary for graduation are distributed among 5 broad groups and include 27 semester credits of formal course work and 3 credits for a creative component. For more information, please contact the College of Engineering.

Master's Double Degree Programs.

A double degree requires fulfillment of the requirements for two graduate majors for which two differently named master's degrees and two diplomas are granted at the same time. For double degrees the final project (thesis or creative component) must integrate subject areas from both degree programs. One final oral examination must be held covering the combined thesis or creative component. Students planning to pursue double degrees must complete a double degree request form and submit it to the Dean of Graduate College for approval. Just one "Recommendation for Committee Appointment" form and one "Program of Study (POS)" form need to be submitted for the two degrees. However, two "Application for Graduation" forms, one for each degree, will need to be submitted. All forms should show clearly that the student is enrolled in a double-degree program.

Like other master's programs, three graduate faculty members can constitute a POS committee; however, POS committees for double degrees must include co-major professors from each of the majors. Although specific degree programs may require more, the program of study must include at least 44 hours of non-overlapping credit (22 for each major) in the two degrees.

Six such combinations are currently available: (1) Master of Architecture/Master of Business Administration; (2) Master of Architecture/Master of Community and Regional Planning; (3) Master of Community and Regional Planning/Master of Business Administration; (4) Master of Landscape Architecture/Master of Community and Regional Planning; (5) Master of Public Administration/Master of Community and Regional Planning; and (6) Master of Science in Statistics/Master of

Business Administration. Other individually combined master's degree programs are available. Please see the *Graduate College Handbook* for more information.

Drake University Law School/Iowa State University Combined Degree. To provide training in the complementary fields of law, political science, and economics with a minimum amount of academic duplication, special arrangements for combined degree programs have been approved with the Drake University Law School. ISU and Drake offer a combined J.D.-M.A. in political science and J.D.-Ph.D. in economics. Drake Law School students are permitted to transfer the equivalent of nine semester credits of specified law courses to ISU for nonmajor graduate credit. Because of the difference in grading systems, the Law School grades are transferred as passes, provided the student has achieved a grade of C or better in those courses at Drake for the political science program or a grade of B or better for the economics program.

Applicants for either of the combined programs must meet the regular entrance requirements of, and be admitted to, both the Drake Law School and the ISU Graduate College.

Specialist in School Psychology

This degree is a post-master's degree in school psychology requiring 60 graduate semester hours of work beyond the baccalaureate. A thesis equivalent to a master's thesis, a practicum totalling at least 600 hours, and a full-time internship of at least 1,500 hours are required. The degree is completed typically through two years of study on campus followed by a full-time internship in a school setting.

Doctor of Philosophy

The degree doctor of philosophy is strongly research oriented. The primary requirements for the degree are: (1) high attainment and proficiency of the candidate in his or her chosen field, (2) development of a dissertation which is a significant contribution to knowledge and which shows independent and creative thought and work, and (3) successful passing of detailed examinations over the field of the candidate's major work, with a satisfactory showing of preparation in related courses. General requirements for Ph.D. candidates are as follows:

Appointment of the Student's Program of Study (POS) Committee. The POS committee for a doctoral program consists of at least five members of the graduate faculty. It must include at least three members, including the major professor, from within the student's major or program. The committee must include members from different majors or different departments so as to ensure diversity of perspectives. A term member of the graduate faculty may participate in the direction of a student's dissertation research as a co-major professor if a member of the graduate faculty serves as a co-major professor and jointly accepts responsibility for direction of the dissertation.

Program of Study. The student and the major professor develop the program of study with the consultation and approval of the POS com-

mittee. This agreement between the student and the Graduate College should be submitted as early as possible for approval. It is recommended that the committee be formed and the POS form submitted as early as the second semester of graduate study but no later than the term before the preliminary oral examination.

Credits. A minimum of 72 graduate credits must be earned for a Ph.D. degree. At least 36 graduate credits, including all dissertation research credits, must be earned at Iowa State University under the supervision of the student's POS committee. There is no specific university requirement regarding the number of credits to be taken inside or outside the major/program.

Transfer Credits. Graduate credits of B grade or better earned as a graduate student at another institution may be transferred at the discretion of the POS committee and the approval of the program and Graduate College.

Transfer credits are normally considered only for graduate course offerings of the college or university that the student attended. Such courses must have been acceptable toward an advanced degree at the institution and must have been taught by individuals having faculty status at the institution. If a student wishes to transfer credits from graduate courses taken at another university as an undergraduate student, it is the student's responsibility to provide verification by letter from that institution that these graduate courses were not taken to satisfy undergraduate requirements for a degree.

Transfer of S and "pass" grades may be accepted for research only when such grades can be documented as being B grade or better. Responsibility for submitting such documentation to the Graduate College rests with the student's POS committee.

Residence. At least 24 semester credits must be earned during two consecutive semesters or during a continuous period including two semesters and a summer session. This requirement does not apply to doctoral students who are employed at least half-time by Iowa State University and government laboratories located in Ames.

Major. A major is the area of study or academic concentration in which a student chooses to qualify for the award of a graduate degree. Majors are listed at the end of this section of the catalog. Opportunities also exist for majoring in more than one area of study (co-major or joint major programs).

Minor. Requirements for declared minors are determined by the minor program and the faculty member representing the minor field on the student's POS committee. The minor subject area must be tested at the preliminary oral and final oral examinations. A minor cannot be added to a program of study after the preliminary oral examination has been taken, nor can a minor be placed on the transcript after graduation, unless it was approved on the program of study, listed on all examination reports, and recorded on the "Application for Graduation" form (diploma slip).

Time Limits. A student beginning a Ph.D. degree program at Iowa State with a master's degree from another institution is expected to complete the Ph.D. within five years, while a student beginning a Ph.D. degree program without the master's degree is expected to complete the program within seven years. In special circumstances the student's program of study committee may recommend that the Dean of the Graduate College extend these degree time limits. Cases in which the student leaves Iowa State during his or her graduate career and later returns are dealt with individually by the student's program of study committee and the Graduate College. The inclusion in the program of study of coursework that is beyond the time limits ("over-age" courses) must be justified by the POS committee in a statement accompanying the submission of the program of study.

Preliminary Examination. The student must pass satisfactorily a preliminary examination before becoming a doctoral candidate. The candidate must have an approved program of study and committee before the preliminary examination can be scheduled. This examination is comprehensive and should not be restricted only to the content of graduate courses. It usually has two parts: a written examination followed by an oral examination. The oral examination is mandatory, and all members of the student's POS committee must be present. In some programs, completion of the written examination is considered a prerequisite to taking the oral examination. A preliminary oral examination is not scheduled for a student on provisional or restricted admission or on academic probation. All students must meet the graduate English requirement before taking the preliminary examination.

The preliminary examination is usually given before all coursework has been completed, and must be passed at least six months before the final examination. Exceptions to this rule are made only upon special recommendation of the student's committee and approval of the Dean of the Graduate College. If a minor is declared, the preliminary examination must cover both the major and minor. The student must be registered for at least the equivalent of 2 credits, or for the R-credit course GR ST 600 (Examination Only) if no coursework is required.

Application for Graduation. Application for graduation should be made by the end of the first week of the semester (fall or spring) in which the student expects to receive the degree, or by the last day of the spring semester if graduation is planned during summer session. To apply for graduation, the student is required to submit to the Graduate College a signed "Application for Graduation" form. Before submitting this form, a student must have submitted and had approved by the Graduate College a "Recommendation for Committee Appointment" form and a "Program of Study" form. Also the student must have been fully admitted to a program and have met the Graduate English requirement. Graduation may be delayed if the "Application for Graduation" form filing deadline is not met. If it becomes apparent that a

student cannot graduate during the indicated term, he/she should call the Graduate College (515-294-4531) and cancel the previously submitted "Application for Graduation" form. The student must then file a new form for the next planned term of graduation.

Dissertation. A doctoral dissertation shall be completed on a topic connected with the major field. To be acceptable, it must constitute a significant contribution to knowledge. Joint authorship is not permitted. The student should consult *The Graduate College Thesis Manual* for instructions about dissertation preparation and time schedules. Copies of the manual are available in the Thesis Office, 203 Beardshear, in the Graduate College Office, 207 Beardshear, or on the Graduate College web site at www.grad-college.iastate.edu.

A complete, unbound copy of the dissertation must be submitted to the Thesis Office for a format check by the first submission deadline of the semester in which a student intends to graduate or before the "Request for Oral Examination" form is filed, whichever comes first. Copies of the completed dissertation must be in the hands of the POS committee at least two weeks before the final examination. The appropriate number of unbound, signed copies of the dissertation must be submitted to the Thesis Office, 203 Beardshear, after the final examination and at least two weeks before graduation. A dissertation processing fee is charged during the term in which the student intends to graduate.

Final Oral Examination. The final oral examination must be held by the final examination deadline date for the semester in which the degree is granted. All coursework in the program of study must either be completed or in progress before the final examination can be scheduled. This examination is oral; it may also include a written component if specified by the student's POS committee. It is intended principally as a defense of the dissertation.

Graduate students must register for the equivalent of two credits, or for the R-credit course GR ST 600 (Examination Only) if no course work is needed, during the semester in which the final examination is taken. If the examination is taken during the interim between terms (including the first day of classes), registration can be for the term either before or after the examination is held.

Graduate Student Approval Slip for Graduation. Every candidate for an advanced degree is required to complete a "Graduate Student Approval Slip for Graduation" form. It is sent to the major professor or program to give to the student after the "Request for Final Examination" form is received and approved by the Graduate College. Signatures are required by the major program, the Thesis Office, and the Graduate College. Final clearance of academic requirements will be made when current term grades have been submitted and evaluated by the Graduate College.

All incompletes from previous terms must be completed by the deadline for completion of the Graduate Student Approval Slip. If a conditional pass was recommended at the final oral examination, the major professor and the com-

mittee members, if so specified, must notify the Graduate College in writing no later than the due date for the Graduate Student Approval Slip for the term of graduation that the conditions have been met.

Summary of Graduate Majors

(More information on each major can be found in the Courses and Programs section of this catalog under the department listed in parentheses after the degree information.)

Aerospace Engineering: M.Eng., M.S., Ph.D. (see Aerospace Engineering and Engineering Mechanics)

Agricultural Economics: M.S., Ph.D. (see Economics)

Agricultural Education: M.S., Ph.D. (see Agricultural Education and Studies)

Agricultural Engineering: M. Eng., M.S., Ph.D. (see Agricultural and Biosystems Engineering)

Agricultural History and Rural Studies: Ph.D. (see History)

Agricultural Meteorology: M.S., Ph.D. (see Agronomy)

Agronomy: M.S. (see Agronomy)

Analytical Chemistry: M.S., Ph.D. (see Chemistry)

Animal Breeding: M.S., Ph.D., (see Animal Science)

Animal Ecology: M.S., Ph.D. (see Animal Ecology)

Animal Nutrition: M.S., Ph.D. (see Animal Science)

Animal Production: M.S. (see Animal Science)

Anthropology: M.A. (see Anthropology)

Applied Mathematics: M.S., Ph.D. (see Mathematics)

Applied Physics: M.S., Ph.D. (see Physics and Astronomy)

Architectural Studies: M.S. (see Architecture)

Architecture: M. Arch., M. Arch./M.B.A., M. Arch./M.C.R.P. (see Architecture)

Art and Design: M.A. (see Art and Design)

Astrophysics: M.S., Ph.D. (see Physics and Astronomy)

Biochemistry: M.S., Ph.D. (see Biochemistry, Biophysics and Molecular Biology)

Biomedical Engineering: M.S., Ph.D. (see Biomedical Engineering)

Biophysics: M.S., Ph.D. (see Biochemistry, Biophysics and Molecular Biology)

Botany: M.S., Ph.D. (see Botany)

Business Administration: M.B.A., M. Arch./M.B.A., M.B.A./M.C.R.P., M.B.A./M.S. (Statistics) (see Business Administration)

Business Administrative Sciences: M.S. (see Business Administration)

- Chemical Engineering:** M. Eng., M.S., Ph.D. (see Chemical Engineering)
- Chemistry:** M.S., Ph.D. (see Chemistry)
- Civil Engineering:** M.S., Ph.D. (see Civil and Construction Engineering)
- Community and Regional Planning:** M.C.R.P., M. Arch./M.C.R.P., M.B.A./M.C.R.P., M.L.A./M.C.R.P., M.P.A./M.C.R.P. (see Community and Regional Planning)
- Computer Engineering:** M.S., Ph. D. (see Electrical and Computer Engineering)
- Computer Science:** M.S., Ph.D. (see Computer Science)
- Condensed Matter Physics:** M.S., Ph. D. (see Physics and Astronomy)
- Crop Production and Physiology:** M.S., Ph.D (see Agronomy)
- Earth Science:** M.S., Ph. D. (see Geological and Atmospheric Sciences)
- Ecology and Evolutionary Biology:** M.S., Ph.D. (see Ecology and Evolutionary Biology)
- Economics:** M.S., Ph.D. (see Economics)
- Education:** M.Ed., M.Ed. Practitioner, M.S., Ph.D. (see Curriculum and Instruction, Educational Leadership and Policy Studies)
- Electrical Engineering:** M.S., Ph.D. (see Electrical and Computer Engineering)
- Engineering Mechanics:** M.Eng., M.S., Ph.D. (see Aerospace Engineering and Engineering Mechanics)
- English:** M.A. (see English)
- Entomology:** M.S., Ph.D. (see Entomology)
- Exercise and Sport Science:** M.S. (see Health and Human Performance)
- Family and Consumer Sciences:** M.F.C.S. (see College of Family and Consumer Sciences)
- Family and Consumer Sciences Education:** M.Ed., M.S., Ph. D (see Family and Consumer Sciences Education and Studies)
- Fisheries Biology:** M.S., Ph. D. (see Animal Ecology)
- Food Science and Technology:** M.S., Ph.D. (see Food Science and Human Nutrition)
- Forestry:** M.S., Ph.D. (see Forestry)
- Genetics:** M.S., Ph.D. (see Genetics)
- Geology:** M.S., Ph.D. (see Geological and Atmospheric Sciences)
- Graphic Design:** M.F.A. (see Art and Design)
- High Energy Physics:** M.S., Ph.D. (see Physics and Astronomy)
- History:** M.A. (see History)
- History of Technology and Science:** M.A., Ph.D. (see History)
- Horticulture:** M.S., Ph.D. (see Horticulture)
- Hotel, Restaurant, and Institution Management:** M.S., Ph.D. as a joint major in a related department (see Hotel, Restaurant, and Institution Management)
- Human Development and Family Studies:** M.S., Ph.D. (see Human Development and Family Studies)
- Immunobiology:** M.S., Ph.D. (see Microbiology, Immunobiology and Preventive Medicine)
- Industrial Education and Technology:** M.S., Ph.D. (see Industrial Education and Technology)
- Industrial Engineering:** M.S., Ph.D. (see Industrial and Manufacturing Systems Engineering)
- Industrial Relations:** M.S. (see Industrial Relations)
- Inorganic Chemistry:** M.S., Ph.D. (see Chemistry)
- Interdisciplinary Graduate Studies:** M.A., M.S (see Interdisciplinary Graduate Studies)
- Interior Design:** M.F.A. (see Art and Design)
- Journalism and Mass Communication:** M.S. (see Journalism and Mass Communication)
- Landscape Architecture:** M.L.A., M.L.A./M.C.R.P. (see Landscape Architecture)
- Materials Science and Engineering:** M.S., Ph.D. (see Materials Science and Engineering)
- Mathematics:** M.S., Ph.D. (see Mathematics)
- Meat Science:** M.S., Ph.D. (see Animal Science, Food Science and Human Nutrition (offered as Ph.D. only jointly with Animal Science))
- Mechanical Engineering:** M.S., Ph.D. (see Mechanical Engineering)
- Meteorology:** M.S., Ph.D. (see Geological and Atmospheric Sciences)
- Microbiology:** M.S., Ph.D. (see Microbiology)
- Molecular, Cellular, and Developmental Biology:** M.S., Ph.D. (see Molecular, Cellular, and Developmental Biology)
- Muscular Biology:** M.S., Ph.D. (see Animal Science)
- Neuroscience:** M.S., Ph.D. (see Neuroscience)
- Nuclear Physics:** M.S., Ph.D. (see Physics and Astronomy)
- Nutrition:** M.S., Ph.D. (see Food Science and Human Nutrition)
- Nutritional Physiology:** M.S., Ph.D. (see Animal Science)
- Operations Research (must be a joint major with Statistics):** M.S. (see Industrial and Manufacturing Systems Engineering/Statistics)
- Organic Chemistry:** M.S., Ph.D. (see Chemistry)
- Physical Chemistry:** M.S., Ph.D. (see Chemistry)
- Physics:** M.S., Ph.D. (see Physics and Astronomy)
- Physiology of Reproduction:** M.S., Ph.D. (see Animal Science)
- Physiology:** M.S., Ph.D. (see Biomedical Sciences)
- Plant Breeding:** M.S., Ph.D. (see Agronomy)
- Plant Pathology:** M.S., Ph.D. (see Plant Pathology)
- Plant Physiology:** M.S., Ph.D. (see Plant Physiology)
- Political Science:** M.A., M.P.A. (see Political Science)
- Professional Agriculture:** M.Ag. (see Professional Agriculture)
- Psychology:** M.S., Ph.D. (see Psychology)
- Public Administration:** M.P.A., M.P.A./M.C.R.P. (see Political Science)
- Rhetoric and Professional Communication:** Ph.D. (see English)
- Rural Sociology:** M.S., Ph.D. (see Sociology)
- School Mathematics:** M.S.M. (see Mathematics)
- School Psychology: Specialist** (see Psychology)
- Sociology:** M.S., Ph.D. (see Sociology)
- Soil Science:** M.S., Ph.D. (see Agronomy)
- Statistics:** M.S., M.B.A./M.S., Ph.D. (see Statistics)
- Systems Engineering:** M.Eng. (see Systems Engineering)
- Textiles and Clothing:** M.S., Ph.D. (see Textiles and Clothing)
- Toxicology:** M.S., Ph.D. (see Toxicology)
- Transportation:** M.S. (see Transportation)
- Veterinary Anatomy:** M.S., Ph.D. (see Biomedical Sciences)
- Veterinary Clinical Sciences:** M.S. (see Veterinary Clinical Science)
- Veterinary Microbiology:** M.S., Ph.D. (see Veterinary Microbiology and Preventive Medicine)
- Veterinary Pathology:** M.S., Ph.D. (see Veterinary Pathology)
- Veterinary Preventive Medicine:** M.S. (see Veterinary Microbiology and Preventive Medicine)
- Water Resources:** M.S., Ph.D. (see Water Resources)
- Wildlife Biology:** M.S., Ph.D. (see Animal Ecology)
- Zoology:** M.S., Ph.D (see Zoology and Genetics)

Courses and Programs

Information About Courses

Course Numbers

The courses in each department are numbered from 1 to 699, according to the following groups:

- 1-99 Courses not carrying credit toward a degree.
- 100-299 Courses primarily for freshman and sophomore students.
- 300-499 Courses primarily for junior and senior students.
- 500-599 Courses primarily for graduate students, but open to qualified undergraduates.
- 600-699 Courses for graduate students only.

Credits and Contact Hours

The academic value of each course is stated in semester credits. Each credit is normally earned by attending one (50-minute) hour of lecture or recitation per week for the entire semester, or by attending a laboratory or studio period of two or three hours per week. In addition, undergraduate students typically will be expected to spend two hours in preparation outside of class for each lecture or recitation hour; additional outside work may be required for laboratory or studio classes.

Each course states the number of semester credits assigned to the course, preceded in parentheses by the number of hours in class (contact hours) expected of the student. The first of the two contact-hour numbers indicates the number of lecture or recitation class hours per week for the semester. The second is the number of laboratory or studio hours required per week. Laboratory and studio hours may include some time devoted to lectures and recitations.

The term "Cr. arr." means that the amount of credit is arranged in advance between the student and the instructor. The credit to be earned depends on the amount of work expected of the student, in accordance with the policy that some combination of teacher-student contact and outside work by the student involving at least three hours per week for the entire semester is required for each credit.

The term "Cr. R." means that the course is required in a certain curriculum or as cognate to one or more other courses. It is also used for cooperative education courses and for some optional inspection trips, study tours, and professional development courses for which numerical credit is not granted.

Semester of Offering

Within each course description may be found one or more of the following letters: F. S. SS., indicating which term—fall, spring, summer session—of the academic year the course is

offered. "Alt." is the abbreviation for alternate. The abbreviation "Yr." is used to designate a sequence of two courses taught fall and spring, respectively. If there is sufficient demand, courses may be offered more frequently than announced. Insufficient demand or unforeseen staffing problems may result in the cancellation of announced offerings. Students are advised to refer to the *Schedule of Classes* or consult with departments for up-to-date course schedule information.

Course Prerequisite

A prerequisite indicates the specific academic background or general academic maturity considered necessary for the student to be ready to undertake the course. Prerequisites are usually stated in terms of specific courses, but equivalent preparation is usually acceptable. An instructor may, however, direct a student whose background does not meet the stated prerequisite, or its equivalent, to drop the course. Conversely, an instructor may waive the prerequisite for a course for which he or she is responsible. Thus, permission of the instructor is understood to be an alternate to the stated prerequisites in all courses.

Cross-listed Courses

A course may be listed with its complete description in one department, and without its description in another department. In both cases, the department with which the course is cross-listed is noted in parentheses. The department in which the full description appears is responsible for the course, but credit for the course may also be obtained through the department in which it is cross-listed.

Co-listed Courses

A course, including its complete description, may be listed in two or more departments, with the department or departments co-listing the course being noted in parentheses in each case. All departments in which the course is listed share responsibility for its offering, and credit for it may be obtained through any of the departments in which it is listed.

Dual-listed Courses

Dual-listed courses permit undergraduate and graduate students to be in the same class but to receive credit under two different course numbers. Credit in the graduate course is not available to students who have received credit in the corresponding undergraduate course. Both graduates and undergraduates receive the same amount of credit for the course, but additional work is required of all graduate students taking the course under the graduate-level course number. This extra work may take the form of additional reading, projects, examinations, or other assignments as determined by the instructor. The instructor must be a member of the Graduate Faculty or a Graduate Lecturer. Each dual-listed course is designated in the catalog with the phrase "Dual-listed with," although the student's official transcript

of credits, both graduate and undergraduate, does not identify dual-listed courses as such. There is a limit to the number of dual-listed course credits that may be used to meet the requirement for an advanced degree. (For information about procedures for requesting permission to offer dual-listed courses, faculty should consult the Graduate Faculty Handbook.)

Priority Enrollment

High demand for courses in certain areas, including engineering, business, and design, has necessitated enrollment management for some courses in those areas. When enrollment priority is established for a course, first consideration is given to students whose curriculum/major explicitly requires the course. After those needs are met, priority is based on the classification of the student, with those nearest graduation receiving first consideration. The Schedule of Classes, published semi-annually, contains current information as to the courses for which priority enrollment is in use.

Special Course Fees

Courses for which special fees are assessed are designated in this course description section along with the specific type of fee charged. Special fee categories include materials fees (which may include consumable materials or other laboratory fees), field trip fees, developmental math fee, and summer camp fees. In some cases, special course fee amounts vary from term to term. Billing and collection of special fees are handled through the university's accounts receivable system.

Additional information on summer camp fees and the developmental math fee may be found in the fees and expenses section on page 17.

Designators

For a list of abbreviations designating departments and programs, see page 51.

Graduate Programs

Graduate Major

A major in the Graduate College is the area of academic professional concentration, approved by the Board of Regents, in which the student chooses to qualify for the award of a graduate degree.

Graduate Area of Specialization

Areas of specialization are indicated in the graduate statements of some departments. This is a subdivision of a major in which a strong graduate-level program is available. When approved by the Graduate College, such

areas of specialization are shown parenthetically after the major on official records, including transcripts and thesis/dissertation title pages.

Interdepartmental Programs

Interdepartmental programs are available at both graduate and undergraduate levels. An interdepartmental program is an administrative structure usually not functioning as a department, ordinarily headed by a supervisory committee, and offering a degree with major(s) in that subject area. Interdepartmental programs have been officially approved and may offer courses.

Nonmajor Graduate Credit

All courses included on the Program of Study of a graduate student must be approved by the student's program of study committee. Usually courses in the major are selected from 500- and 600- level courses in the major. Courses outside of the major can be selected from other 500- and 600- level courses and from 300- and 400- level courses which have been approved for nonmajor graduate credit. In the catalog, the approved 300- and 400- level courses are indicated by the words "Nonmajor graduate credit" in the course description.

Accounting

David B. Smith, Chair of Department

Professors: Hira, Smith

Professors (Emeritus): Brown, Handy

Associate Professors: Bouillon, Dilla, Doran, Jeffrey, Kurtenbach, Maydew, Murphy, Ravenscroft, Swanson

Assistant Professors: Clem, Sergeant, West

Assistant Professors (Adjunct): Curtis

Instructors (Adjunct): Blanshan, Duffy, Mazzitelli

Undergraduate Study

For undergraduate curriculum in business, major in accounting, see *College of Business, Curricula*.

The primary purpose of accounting is to provide relevant information to both internal users (management) and external users such as investors, creditors, government, and the general public. Accounting is an integral part of the management of business and public organizations. Accountants, therefore, participate in planning, evaluating, and controlling the activities of the firm. Accounting is needed by external users in order to make investment decisions, grant or withhold credit, and, in the case of government, to collect revenue and gather statistical information. In order to provide useful information, accountants collect, analyze, synthesize, and report data in an understandable manner.

The instructional objective of the Accounting Program is to provide a well-rounded professional education in accounting. Such an education should provide the student with: (1) a mastery of basic accounting concepts; (2) an

ability to think critically and creatively about accounting problems; (3) an ability to effectively communicate and work with others as a member of a team; (4) an awareness and sensitivity for dealing with ethical concerns.

The major in accounting is designed to give students a conceptual foundation as well as to provide a wide range of basic skills and analytical tools for use in reporting for both public and private concerns. Students who complete the accounting major are well prepared to accept positions in industry, government, and the public accounting profession. Completion of this program meets the current educational requirements for taking the CPA examination as established by the Iowa Accountancy Examining Board. The requirements for the accounting major are met by successful completion of the following courses: Acct 284, 285, 383, 385, 386, 387, 496, and 497, plus one from Acct 388, 486, 487, and 499. See the graduate study curricula in accounting for the upcoming 150 hour education requirement for CPA certification in Iowa.

In addition, it is highly recommended that an accounting major include Business Law (Acct 316). The Department of Accounting should be consulted for information on specific alternative plans of study.

Graduate Study

The department participates in two graduate degree programs: the M.S. in business administrative sciences and the M.B.A. full-time and part-time programs. The M.S. degree in business administrative sciences is a 30-credit curriculum culminating in a thesis. The M.B.A. program is a 48-credit, nonthesis, noncreative component curriculum. Twenty four of the 48 credit hours are core courses and the remaining 24 are graduate electives.

Within the M.B.A. program, students may develop an area of specialization in accounting. This specialization requires that 12 of the 24 credit hours of the graduate electives be from accounting. Included in this 12 credit hour requirement is a three credit hour required course, Acct 598. Due to prerequisites for Acct 598, students without any background in accounting are required to complete 15 credit hours of undergraduate accounting.

The specialization in accounting is designed to meet the upcoming 150 hour education requirement for CPA certification in Iowa.

Fully-admitted M.B.A. degree candidates with previous business study as an undergraduate may qualify for advanced entry into the M.B.A. program. Advanced entry is designed to serve those students with a bachelor's degree in business as they may complete the M.B.A. degree program requirements in as few as 30 semester credit hours. Information about the advanced M.B.A. entry application process can be found in the College of Business Graduate Programs Office, 218 Carver Hall.

Courses open for nonmajor graduate credit: 486, 487, 496, 497, 499.

Courses Primarily for Undergraduate Students

Acct 215. Legal Environment of Business. (3-0) Cr. 3. F.S.SS. *Prereq: Sophomore classification.* General history, structure, and principles of law. The legal system, as an agency of social control; good business practices, and tool for change. The court systems, Constitution, torts, contracts, administrative agencies, and agency law.

Acct 284. Financial Accounting. (3-0) Cr. 3. F.S.SS. Introduction to the basic concepts and procedures of financial accounting from a user perspective. The course examines the accounting cycle, business terminology, basic control procedures, and the preparation and evaluation of financial reports, with an emphasis on financial statement analysis.

Acct 285. Managerial Accounting. (3-0) Cr. 3. F.S.SS. *Prereq: 284.* The essentials of managerial accounting. Methodology and uses of internal managerial reports in cost determination, cost control, pricing, and short-and long-range planning.

Acct 316. Business Law. (3-0) Cr. 3. F.S. *Prereq: 215.* Continuation of 215. Sales under the Uniform Commercial Code, negotiable instruments, secured transactions, property transactions, partnerships, and wills and estates.

Acct 383. Intermediate Managerial Accounting. (3-0) Cr. 3. F.S. *Prereq: 285 or 508.* Generation, communication and use of information to assist management with planning, control, and decision making in manufacturing and service organizations. Includes traditional and contemporary models of cost estimation, assignment, and control, responsibility accounting, and nonrecurring decisions. Emphasis on developing written and oral communication skills, as well as spreadsheet capabilities.

Acct 385. Principles of Federal Income Tax. (3-0) Cr. 3. F.S. *Prereq: 285 or 508.* An overview of the fundamentals of income tax related to individual taxpayers, and concepts applicable to all tax entities. Basic coverage of corporation and partnership income tax. Transaction planning to maximize participation in preferential tax opportunities.

Acct 386. Intermediate Accounting I. (3-0) Cr. 3. F.S. *Prereq: 285 or 508.* The conceptual framework of financial accounting. Communication of financial information on the income and retained earnings statements, statement of cash flows, and the balance sheet. Accounting concepts relating to current and operational assets of the firm.

Acct 387. Intermediate Accounting II. (3-0) Cr. 3. F.S. *Prereq: 386.* Financial accounting and reporting practices for business entities. Generally accepted accounting principles (GAAP) relative to firm equity, income, investments, taxes, employee benefits, leases, accounting changes and cash flows. Discussion of current issues in financial accounting.

Acct 388. Governmental and Non-profit Institution Accounting. (3-0) Cr. 3. F.S. *Prereq: 386 or 508.* Budgeting, accounting, auditing, and financial reporting principles associated with private and public non-profit organizations. Includes survey of state, local, municipal, and federal government accounting, as well as accounting for colleges, universities, public schools, health care facilities, voluntary health and welfare organizations and other not for profit entities.

Acct 486. Advanced Income Tax. (3-0) Cr. 3. F.S. *Prereq: 385, 386.* Advanced topics in individual taxation. A continuation of study in partnership and corporate taxation. Extended study of property transactions. Fiduciary entities. Federal estate and gift taxation. Tax administration and practice Tax planning. Strongly recommended for those who plan a career in public accounting. Nonmajor graduate credit.

Acct 487. Accounting Information Systems. (3-0) Cr. 3. *Prereq: 386.* Analysis of concepts and procedures underlying the automated accumulation and processing of accounting data. EDP internal control and audit techniques. Trends in accounting information systems. Intended for the upper level accounting major. Nonmajor graduate credit.

Acct 490. Independent Study. Cr. 1 to 3 each time taken. F.S.SS. *Prereq:* 285, senior classification, permission of instructor.

Acct 496. Advanced Accounting Problems. (3-0) Cr. 3. F.S. *Prereq:* 387. Partnerships, branch operations, accounting for business combinations and affiliated companies, consolidated financial statements; reporting for multinational operations. Nonmajor graduate credit.

Acct 497. Auditing I. (3-0) Cr. 3. F.S. *Prereq:* 387. The conceptual framework of auditing. Rules of conduct. External reporting concepts. Audit methodology including procedures for gathering evidence. Internal control, audit verification, and the role of statistical sampling in auditing for financial information systems. Nonmajor graduate credit.

Acct 499. Auditing II. (3-0) Cr. 3. *Prereq:* 497. The application of auditing procedures in the audit of the financial affairs of business. Audit and control of computerized systems, fraud auditing. For students with a strong professional interest in auditing. Nonmajor graduate credit.

Courses Primarily for Graduate Students, open to qualified undergraduate students

Acct 508. Survey of Financial and Managerial Accounting. (2-0) Cr. 2. *Prereq:* Graduate classification. A general introduction to both financial and managerial accounting information. Financial topics covered include the use and analysis of financial information, the regulatory environment and the audit function, and the use of the internet and electronic spreadsheets as a means of accessing and analyzing financial data. Managerial topics covered include the use of accounting information as a basis for management decisions, basic cost concepts, cost-volume-profit analysis, just-in-time accounting concepts, and product costing.

Acct 581. Decision Models in Accounting. (3-0) Cr. 3. *Prereq:* 383 or 508. Quantitative and decision-making models such as cost estimation, inventory evaluation, and cost minimization techniques. The focus of decision analysis specifically applied to accounting problems.

Acct 583. New Technology and Management Accounting. (3-0) Cr. 3. *Prereq:* 383 or 508. Just-in-time concepts, capital investment decisions, activity-based costing, product costing, quality costs, and performance measurement decisions. Focus will be specific to accounting issues.

Acct 585. Tax Implications of Business Decisions. (3-0) Cr. 3. S. *Prereq:* 285, 6 credits in accounting or 508. The impact of federal tax legislation on the formation, operation and liquidation or reorganization of entities. Income and estate planning for executives.

Acct 589. Accounting and Taxation of Agricultural Entities. (3-0) Cr. 3. F. *Prereq:* 285, 6 credits in accounting or 508. Financial and cost accounting concepts and procedures for agribusiness operations, including ABC costing, managerial decisions including present value analysis and break-even point analysis. Procedures and planning of income tax, including entity selection. Transfer taxes as related to farming and ranching.

Acct 590. Special Topics. Cr. 1 to 3 each time taken. F.S.SS. *Prereq:* Permission of instructor. For students wishing to do individual research in a particular area of accounting.

Acct 592. Financial Statement Analysis. (3-0) Cr. 3. S. *Prereq:* 284 or 508. The presentation and analysis of financial statement information from the point of view of the primary users of such data: owners and creditors. Topics covered will include the financial reporting system, the primary financial statements, and effects of accounting method choice on reported financial data.

Acct 596. International Accounting. (3-0) Cr. 3. *Prereq:* 284 or 508. Accounting and reporting requirements and managerial issues faced by multinational corporations. The international environment of standard setting will be examined. Technical issues such as transfer pricing, inflation accounting and taxation will be discussed.

Acct 598. Financial Accounting: Theory and Contemporary Issues. (3-0) Cr. 3. F. *Prereq:* 496, 497, and 383 or 385. Theoretical discussion of financial accounting choices and current pronouncements of the Financial Accounting Standards Board. Asset valuation models, income measurement alternatives and cash flow analysis.

Aerospace Engineering

(Administered by the Department of Aerospace Engineering and Engineering Mechanics)

Thomas J. Rudolphi, Chair of Department Distinguished Professors: R. B. Thompson, Young

Professors: Chimenti, Greer, Holger, Inger, Jenison, Jischke, McConnell, McDaniel, Munson, Pierson, Rizzo, Rogge, Rohach, Rothmayer, Rudolphi, Schmerr, Tannehill, Tsai, Wilson, Zachary

Professors (Adjunct): Hsu

Professors (Collaborators): Alers, Fortunko

Distinguished Professors (Emeritus): Riley, D. Thompson

Professors (Emeritus): Akers, Iversen, Weiss

Associate Professors: Dayal, Flatau, Hilliard, Hindman, Lu, Mann, Mitra, Rajagopalan, Sherman, Sturges, Vogel

Associate Professors (Adjunct): Roberts, Trulin

Associate Professors (Emeritus): Hermann, James, Seversike

Assistant Professors: Jacobson, Liljegen, Scheeres

Assistant Professors (Adjunct): Gray, Kellogg, Legg

Undergraduate Study

For undergraduate curriculum in aerospace engineering leading to the degree bachelor of science, see *College of Engineering, Curricula*. This curriculum is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

The aerospace engineer is primarily concerned with the design, analysis, testing, and overall operation of vehicles which operate in an atmosphere, a fluid medium, or outer space as well as on water and land surfaces. The curriculum is designed to provide the student with an education in the fundamental principles of aerodynamics, flight mechanics, propulsion, structural mechanics, controls, design, testing, and space technologies. A wide variety of opportunities awaits the aerospace engineering graduate in research, development, design, production, sales, and management in the aerospace industry, and in many related industries in which fluid flow, control, and transportation problems play major roles.

A cooperative education program in aerospace engineering is available in cooperation with several industries and government agencies. The usual four-year curriculum is extended over a five-year span to permit alternate industrial experience periods and academic periods. This arrangement offers valuable practical experience and financial assistance during the college years. See *College of Engineering, Cooperative Programs*.

Undergraduate Educational Goals and Expected Outcomes:

The Department of Aerospace Engineering and Engineering Mechanics maintains an internationally recognized academic program in aerospace engineering via ongoing consultation with students, faculty, industry, and aerospace professionals. Results of these consultations are used in a process of academic improvement to provide the best possible education for our students.

Academic Program Goal: Provide an effective program that fulfills student needs and that equips and empowers qualified students for a successful career in Aerospace Engineering.

The Aerospace Engineering Program subscribes to all Iowa State University and College of Engineering goals and outcomes, as listed in the Iowa State University catalog. Additionally, the following outcomes can be expected.

1. Students in the undergraduate Aerospace Program will acquire a basic knowledge of mathematics, science and engineering and will be able to apply that knowledge to identify, formulate and solve aerospace engineering problems. They will apply analysis and problem-solving skills to a variety of problems. They will also obtain a comprehensive education in the broad range of liberal and engineering sciences needed to become a successful aerospace professional.
2. Using the techniques, skills and modern engineering tools necessary for aerospace engineering practice, students will learn to function on multi-disciplinary teams to undertake preliminary design of aerospace systems and components. They will also obtain the oral, written, and graphical communication skills needed to communicate the results of their work to peers, supervisors, and others.
3. Students will learn how to design and to conduct experiments and computer simulations, and how to analyze data. They will become proficient in the use of laboratory equipment, computer equipment, and software.
4. Students will acquire a knowledge of contemporary issues necessary to understand the impact of engineering solutions in a global/societal context and will obtain an understanding of their professional and ethical responsibility in formulating such solutions. They will, furthermore, learn the economic, environmental, health and safety, social and political impact of their solutions.
5. Students will recognize the need to engage in life-long learning, independent study, research and engineering development, and

will acquire the ability to pursue these activities. They will be provided opportunities to engage in research, and in independent and group study needed to foster these skills.

6. Students will obtain an understanding of materials used in the construction of aerospace vehicles and the ability to analyze and design aerospace structural elements for flight and space structures.

7. Students will develop the ability to analyze airfoils, wings, and other aerodynamic bodies in both low-speed and high-speed flight, including viscous effects.

8. Students will develop the ability to analyze a variety of propulsion systems, including those for aircraft and spacecraft.

9. Students will develop the ability to analyze the flight mechanics and stability of aircraft and spacecraft, and to design flight control systems for these vehicles.

10. Upon successful completion of the Aerospace Engineering Curriculum, students will be prepared for immediate entry into the aerospace profession, both nationally and internationally, as well as the pursuit of advanced study in aerospace and related disciplines. Students will also be well qualified to pursue careers in fields that use the advanced multi-disciplinary technologies and methods learned in the Aerospace Engineering Curriculum.

Graduate Study

The department offers work for the degrees master of engineering, master of science, and doctor of philosophy with major in aerospace engineering, and minor work to students taking major work in other departments. For all graduate degrees it is possible to establish a co-major program with another graduate degree granting department. Within the aerospace program, work is available in the following areas: aerospace systems design, atmospheric and space flight mechanics, computational fluid dynamics, control systems, environmental fluid mechanics, fluid mechanics, optimization, and structural analysis.

The degrees master of science and doctor of philosophy require an acceptable thesis in addition to the coursework. For the degree master of engineering, a creative component or suitable project is required. Appropriate credit is allotted for this requirement.

Minor work for aerospace engineering majors is usually selected from mathematics, physics, electrical engineering, engineering mechanics, mechanical engineering, and materials science and meteorology.

The normal prerequisite to major graduate work in aerospace engineering is the completion of a curriculum substantially equivalent to that required of aerospace engineering students at this university. However, because of the diversity of interests within the graduate programs in aerospace engineering, a student whose prior undergraduate or graduate education has been in allied engineering and/or scientific fields may also qualify. In such cases, it may be necessary for the student to take addi-

tional work to provide the requisite background. A prospective graduate student is urged to specify the degree program and the specific field(s) of interest on the application for admission.

Courses normally will be offered at the times stated in the course description. Where no specific time of offering is stated, the course may be offered during any semester provided there is sufficient demand.

Courses open for nonmajor graduate credit: 311, 312, 322, 331, 343, 351, 356, 361, 412, 421, 422, 423, 426, 432, 441, 442, 446, 451, 461, 462, 464, 471.

Courses Primarily for Undergraduate Students

Aer E 170. Engineering Graphics Fundamentals. (Same as E Sci 161.) (0-4) Cr. 2. F.S. *Prereq:* *Math 141 or 142 or satisfactory scores on mathematics placement examinations; credit or enrollment in Math 165.* Graphical description of geometry with freehand techniques. Introduction to geometric modeling with parametric modeling software. Emphasis on visualization, multiviews, and size definition.

Aer E 192. Aerospace Seminar. (1-0) Cr. R. S. Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Academic program planning, short course and departmental symposium participation.

Aer E 201. Introduction to Aerospace Engineering. (3-0) Cr. 3. F.S. *Prereq:* *Math 166, Phys 221, Engr 160 or 161 or proficiency in a computer language, Aer E 170.* Introduction to aerospace disciplinary topics, including: aerodynamics, structures, propulsion, flight mechanics and astrodynamics.

Aer E 202. Instrumentation Laboratory I. (0.5-4.5) Cr. 2. F.S. *Prereq:* *Math 166, Engr 160 or 161, credit or enrollment in Phys 221.* Proficiency with basic instrumentation utilized in other Aer E laboratory courses. Computer usage. Probes and data acquisition equipment for fluid mechanics and structural mechanics. Operation, accuracy, and errors of instruments, experiment design, reporting results, and observation of basic phenomena.

Aer E 243. Aerodynamics I. (3-0) Cr. 3. F.S. *Prereq:* *201 and Math 265.* Introduction to fluid mechanics and aerodynamics. Fluid properties, statics, and kinematics. Conservation equations in differential and integral form. Bernoulli's equation. Dimensional analysis. Basic potential flow concepts and solutions. Examples of numerical methods. Applications of multi-variable calculus to fluid mechanics and aerodynamics.

Aer E 243L. Aerodynamics Laboratory. (0-3) Cr. 0.5. F.S. (8 weeks) *Prereq:* *201, credit or enrollment in Aer E 243.* Introduction to fluid dynamic principles and instruments in aerodynamics through laboratory studies and experiments. Report writing.

Aer E 264. Introduction to Space Systems and Science. (Same as E E 264.) (3-0) Cr. 3. *Prereq:* *Phys 221.* Space environment. Launch vehicles. Orbital mechanics. Spacecraft systems including communications, power, guidance, commands and data processing. Science from space including astronomy, meteorology, geology, earth observing, and planetary exploration.

Aer E 291. Aerospace Seminar. (1-0) Cr. R. F. Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Academic program planning, short course and departmental symposium participation.

Aer E 292. Aerospace Seminar. (1-0) Cr. R. S. Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Academic program planning, short course and departmental symposium participation.

Aer E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of department; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Aer E 301. Flight Experience. Cr. R. F.S.SS. *Prereq:* *Credit or enrollment in 356.* Two hours of in-flight training and necessary ground instruction. Course content prescribed by the Aerospace Engineering and Engineering Mechanics Department. Four hours of flight training certified in a pilot log book can be considered by the course instructor as evidence of satisfactory performance in the course. Materials fee.

Aer E 311. Thermodynamics and Gas Dynamics for Aerospace Engineers. (4-0) Cr. 4. F.S. *Prereq:* *243.* 1st and 2nd laws of thermodynamics, properties of liquids and gases, thermodynamic processes and relations, energy equation, compressible flow, shock and expansion waves, isentropic flow, Fanno and Rayleigh flow. Nonmajor graduate credit.

Aer E 311L. Gas Dynamics Laboratory. (0-3) Cr. 0.5. F.S. (8 weeks) *Prereq:* *243, 243L, credit or enrollment in 311.* Introduction to experimental compressible flow and propulsion principles, techniques and instruments through laboratory studies and experiments. Report writing.

Aer E 312. Aerospace Vehicle Propulsion I. (3-0) Cr. 3. F.S. *Prereq:* *311.* Momentum theorem, thrust and propulsive efficiency. Thermodynamics of compressible flow with heat addition. Components and principles of turbojets and turbofans. Rocket engines and ramjet principles. Engine/airframe integration. Nonmajor graduate credit.

Aer E 322. Flight Structure I. (4-3) Cr. 5. F. *Prereq:* *EM 324.* Introduction to structural analysis of flight vehicles. Load determination on flight structures. Material selection. Static, fatigue, fracture, thermal and stability analysis of structures. Shear flow in closed and open sections. Analysis of structural elements-trusses, beams, shear webs, torque boxes and frames. Introduction to work/energy principles. Lab: Introduction to experimental strain measurements. Testing of riveted joints, truss elements. Shear and bending stresses in closed sections. Buckling of beams and plates. Nonmajor graduate credit.

Aer E 331. Flight Control Systems I. (3-0) Cr. 3. F.S. *Prereq:* *356.* Linear system analysis. Control system designs using root-locus and frequency response methods. Applications in flight control systems. Nonmajor graduate credit.

Aer E 340. Introduction to Aerodynamics and Space Flight. (3-0) Cr. 3. F.S. *Prereq:* *Math 265, Phys 221.* Aerodynamics of flight vehicles. Dynamics of space flight. For nonaerospace engineering students.

Aer E 343. Aerodynamics II. (3-0) Cr. 3. F.S. *Prereq:* *311.* Incompressible, subsonic, transonic, supersonic, hypersonic flow over airfoils and wings. Viscous flow theory. Laminar boundary layers. Transition and turbulent flow. Nonmajor graduate credit.

Aer E 343L. Advanced Aerodynamics and Propulsion Laboratory. (0-3) Cr. 1. F.S. *Prereq:* *311L, credit or enrollment in 312 and 343.* Advanced concepts in aerodynamics and propulsion through laboratory experience. Experiments to include model tests. Techniques in subsonic and supersonic measurements. Report writing.

Aer E 351. Astrodynamics I. (3-0) Cr. 3. F.S. *Prereq:* *Math 265, E M 345.* Introduction to astrodynamics. Two-body motion. Geocentric, Lunar and interplanetary trajectories and applications. Launch and atmospheric re-entry trajectories. Nonmajor graduate credit.

Aer E 356. Flight Vehicle Performance, Stability and Control. (4-2) Cr. 5. F.S. *Prereq:* *Math 267, E M 345.* Performance of aerospace vehicles. Aircraft rigid body equations of motion. Longitudinal and lateral-directional static and dynamic stability and control. Flight handling characteristics. Nonmajor graduate credit.

Aer E 361. Computational Techniques for Aerospace Design. (1-4) Cr. 3. F.S. *Prereq:* *Credit or enrollment in 322, 343 and 356.* Advanced programming, workstation environment, and development of computational tools for aerospace analysis and design. Nonmajor graduate credit.

Aer E 391. Aerospace Seminar. (1-0) Cr. R. F. Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Academic program planning, short course and departmental symposium participation.

Aer E 392. Aerospace Seminar. (1-0) Cr. R. S. Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Academic program planning, short course and departmental symposium participation.

Aer E 396. Summer Internship for International Students. Cr. R. SS. *Prereq:* *Permission of department.* Summer professional work period for international students.

Aer E 397. Engineering Internship. Cr. R. F.S. *Prereq:* *Permission of department.* Professional work period, one semester maximum per academic year.

Aer E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of department; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Aer E 402. Instrumentation Laboratory II. (0.5-4.5) Cr. 1. F.S. (8 weeks.) *Prereq:* *202 and all other Aer E Lab courses.* In depth understanding of instrumentation, based on experience with instrumentation used in other laboratories. Operation of instruments so that causes of errors are understood. Design of experiments to minimize instrumentation limitations and errors.

Aer E 412. Aerospace Vehicle Propulsion II. (3-0) Cr. 3. F. S. *Prereq:* *312.* Propulsion system performance. Propellers, axial flow compressors, turbines, and fans. Engine core and jet noise. Solid and liquid rocket engines. Nuclear and electric propulsion. Nonmajor graduate credit.

Aer E 421. Flight Structures II. (3-0) Cr. 3. F.S. *Prereq:* *322.* Advanced topics in flight structural analysis. Introduction and application of finite element methods to beams, frames, plates, shells and semi-monocoque structures. Modal, transient dynamic analysis, and stability and buckling analysis of flight structures. Nonmajor graduate credit.

Aer E 422. Advanced Structures. (2-2) Cr. 3. F. S. *Prereq:* *421.* Advanced topics in flight structural analysis and testing. Thermal loads and effects on material selection and stress analysis. Flutter analysis and testing. Nonmajor graduate credit.

Aer E 423. Composite Flight Structures. (2-2) Cr. 3. S. *Prereq:* *E M 324.* Fabrication, testing and analysis of composite materials used in flight structures. Basic laminate theory of beams, plates and shells. Manufacturing and machining considerations of various types of composites. Testing of composites for material properties, strength and defects. Student projects required. Lab fee. Nonmajor graduate credit.

Aer E 426. Design of Aerospace Structures. (1-6) Cr. 3. F.S. *Prereq:* *E M 324.* Detailed design and analysis of aerospace vehicle structures. Material selection, strength, durability and damage tolerance, and validation analysis. Design for manufacturability. Introduction to concepts of expert systems in design. Nonmajor graduate credit.

Aer E 432. Flight Control Systems II. (3-0) Cr. 3. S. *Prereq:* *331.* Aircraft lateral directional stability augmentation. Launch vehicle pitch control system design. Control of flexible vehicles. Satellite attitude control. Flight control designs based on state-space methods. Introduction to sample-data systems. Nonmajor graduate credit.

Aer E 441. Viscous Flow Theory. (3-0) Cr. 3. F.S. *Prereq:* *343.* Navier-Stokes equations. Laminar and turbulent boundary layers. Exact, approximate and numerical solutions. Compressibility effects. Turbulence modeling. Nonmajor graduate credit.

Aer E 442. V/STOL Aerodynamics and Performance. (3-0) Cr. 3. F. S. *Prereq:* *356.* Introduction to the aerodynamics, performance, stability, control and critical maneuvering characteristics of V/STOL vehicles. Topics include hovercrafts, jet flaps, ducted fans and thrust vectored engines. Nonmajor graduate credit.

Aer E 446. Computational Fluid Dynamics. (3-0) Cr. 3. F.S. *Prereq:* *343.* Introduction to modern computational fluid dynamics. Finite difference and finite volume methods. Explicit, implicit, and iterative techniques. Solutions of elliptic, parabolic, and hyperbolic equations. Emphasis on applications. Commercial software. Nonmajor graduate credit.

Aer E 451. Astrodynamics II. (3-0) Cr. 3. S. *Prereq:* *351.* Orbit determination and prediction. Transfer orbits using the universal variable formulation. Relative motion in orbit. Perturbation methods applied to trajectory analysis. Introduction to the N-body problem. Nonmajor graduate credit.

Aer E 461. Modern Design Methodology with Aerospace Applications. (2-2) Cr. 3. F.S. *Prereq:* *367.* Modern engineering design process including quality and manufacturability, design optimization, probabilistic design, materials and strength considerations, durability, reliability and damage tolerance. Nonmajor graduate credit.

Aer E 462. Design of Aerospace Systems. (1-4) Cr. 3. F.S. *Prereq:* *461.* Fundamental principles used in engineering design of aircraft missile and space systems. Preliminary design of aerospace vehicles. Nonmajor graduate credit.

Aer E 464. Spacecraft Mission and Systems Analysis. (3-0) Cr. 3. F. *Prereq:* *351.* Mission design and navigation of satellite and spacecraft missions. Introduction to low thrust trajectory dynamics. Attitude sensing and control. Launch vehicle integration and payload mass analysis. Scientific measurements from space. Introduction to communication, power, thermal and structure constraints. Nonmajor graduate credit.

Aer E 471. Theory and Practice in Modern Experimental Aerothermal Sciences. (2-2) Cr. 3. F.S. *Prereq:* *343, 343L.* Theoretical and design aspects of experimental aerodynamic and propulsion measurement techniques and instruments. Subsonic, transonic and supersonic wind tunnels and their use. Shock tubes. Nonmajor graduate credit.

Aer E 490. Independent Study. Cr. 1 to 6. Arr. *Prereq:* *Junior or senior classification, approval of the department.*
A. Aero and/or Gas Dynamics
B. Propulsion
C. Aerospace Structures
D. Flight Mechanics
E. Spacecraft Systems
F. Flight Control Systems
G. Aeroelasticity
H. Honors
I. Design

Aer E 491. Aerospace Seminar. (1-0) Cr. R. F. S. Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Academic program planning, short course and departmental participation.

Aer E 492. Aerospace Seminar. (1-0) Cr. R. F.S. Professional skills development activities. Designed to encourage involvement in a variety of aerospace engineering activities and related professional activities. Academic program planning, short course and departmental symposium participation.

Aer E 493. Aerospace Symposium. (1-0) Cr. R. F.S. *Prereq:* *Senior classification.* Presentation of a technical paper at the departments fall or spring Aerospace Symposium or at a recognized student or professional meeting of the American Institute of Aeronautics and Astronautics (AIAA).

Aer E 494. Senior Project. Cr. 1 to 3. F.S. *Prereq:* *Senior classification.* Development of aerospace principles and concepts through individual or group projects.

Aer E 495. Senior Project. Cr. 1 to 3. S. *Prereq:* *Senior classification.* Development of aerospace principles and concepts through individual or group projects.

Aer E 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of department; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, open to qualified undergraduate students

Aer E 514. Advanced Mechanics of Materials. (Same as EM 514.) See *Engineering Mechanics.*

Aer E 517. Experimental Stress Analysis. (Same as E M 517). See *Engineering Mechanics.*

Aer E 521. Airframe Analysis. (3-0) Cr. 3. S. *Prereq:* *421 or E M 425.* Analysis of static stresses and deformation in continuous aircraft structures. Various analytical and approximate methods of analysis of isotropic and anisotropic plates and shells.

Aer E 524. Numerical Mesh Generation. (Same as E M 524 and M E 524). (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* *Math 385.* Introduction to modern mesh generation techniques. Structured and unstructured mesh methods, algebraic and PDE methods, elliptic and hyperbolic methods, variational methods, error analysis, Delaunay triangulation, data structures, geometric modeling with B-spline and NURBS surfaces, surface meshing.

Aer E 525. Finite Element Analysis. (Same as E M 525). See *Engineering Mechanics.*

Aer E 531. Automatic Control of Flight Vehicles. (3-0) Cr. 3. S. *Prereq:* *331.* Applications of classical and modern linear control theory to automatic control of flight vehicles. Spacecraft attitude control. Control of flexible vehicles. Linear-quadratic regulator and pole-placement design applications.

Aer E 533. Thermodynamics of Compressible Flow II. (Same as M E 533.) See *Mechanical Engineering.*

Aer E 541. Incompressible Flow Aerodynamics. (3-0) Cr. 3. F. *Prereq:* *343 or M E 335.* Kinematics and dynamics of fluid flow. Derivation of the Navier-Stokes, Euler and potential flow equations. Introduction to generalized curvilinear coordinates. Ideal fluids. Two-dimensional and three-dimensional potential flow. Complex variable methods.

Aer E 542. Compressible Flow Aerodynamics. (3-0) Cr. 3. S. *Prereq:* *541.* Viscous and inviscid compressible flow equations. Shock equations for normal, oblique and curved shocks. Exact solutions. Linear theory and Prandtl-Glauert similarity. Subsonic, transonic, supersonic and hypersonic flows. Method of characteristics.

Aer E 543. Viscous Flow Aerodynamics. (3-0) Cr. 3. S. *Prereq:* *541.* Navier-Stokes equations. Incompressible and compressible boundary layers. Similarity solutions. Computational and general solution methods. Introduction to stability of laminar flows, transition and turbulent flow.

Aer E 544. Applied Wing Theory. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* *542.* Potential flow methods. Linear theory. Aerodynamics of wings and bodies. Similarity rules. Applied computational methods. Sensitivity analysis.

Aer E 546. Computational Fluid Mechanics and Heat Transfer I. (Same as M E 546.) (3-0) Cr. 3. F. Introduction to finite difference and finite volume methods used in modern engineering. Basic concepts of discretization, consistency, and stability. Applications of numerical methods to selected model partial differential equations.

Aer E 547. Computational Fluid Mechanics and Heat Transfer II. (Same as M E 547.) (3-0) Cr. 3. S. *Prereq:* *546.* Application of computational methods to current problems in fluid mechanics and heat transfer. Methods for solving the Navier-Stokes and reduced equation sets such as Euler, boundary layer, and parabolized forms of the conservation equations.

Introduction to relevant aspects of grid generation and turbulence modeling.

Aer E 551. Orbital Mechanics. (3-0) Cr. 3. F. *Prereq:* 351. Review of 2-body problem. Orbit perturbation analysis. Gravity field expansions and effects on orbiters. 3-body problem with applications.

Aer E 552. Entry Dynamics. (3-0) Cr. 3. *Prereq:* 551. Atmospheric entry and entry dynamics of missiles and spacecraft. Trajectory control. Descent and landing. Thermal protection considerations. Entry vehicle attitude control.

Aer E 555. Atmospheric Flight Mechanics. (3-0) Cr. 3. *Prereq:* 356. Use of energy methods and optimization in the performance analysis of highly maneuverable aircraft and missiles. Stability and control analysis of flight vehicles.

Aer E 556. Guidance and Navigation of Aerospace Vehicles. (3-0) Cr. 3. F. *Prereq:* 331. Principles of guidance systems for spacecraft, launch vehicles, homing and ballistic missiles. Optimal guidance. Interplanetary transfer guidance with low thrust. Principles of inertial navigation. Theory and applications of the Global Positioning System. Celestial navigation procedures. Application of Kalman filtering to recursive navigation theory.

Aer E 561. Modern Aerospace Design Methodology. (2-2) Cr. 3. S. *Prereq:* 322, 331, 343, 351, and proficiency in FORTRAN programming. Principles and methodology of optimal and statistical design applied to aerospace structural, fluid dynamic, flight dynamic, control systems, and applications.

Aer E 565. Systems Engineering and Analysis. (Same as E E 565, I E 565.) (3-0) Cr. 3. F. *Prereq:* Graduate classification in engineering. Introduction to organized multidisciplinary approach to designing and developing systems. Concepts, principles, and practice of systems engineering as applied to large integrated avionics systems. Life-cycle costing, scheduling, risk management, functional analysis, conceptual and detail design, test evaluation, and production.

Aer E 566. Avionics Systems Engineering. (Same as E E 566.) (3-0) Cr. 3. S. *Prereq:* 565. Avionics functions. Applications of systems engineering principles to avionics. Top-down design of avionics systems. Automated design tools.

Aer E 569. Mechanics of Composite and Combined Materials. (Same as E M 569.) See *Engineering Mechanics*.

Aer E 571. Environmental Aerodynamics. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 541. Survey of atmospheric turbulence, turbulent diffusion, and velocity profile within the atmospheric boundary layer with emphasis on modeling by means of the environmental wind tunnel.

Aer E 572. Turbulence. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 541. Qualitative features of turbulence. Statistical and spectral representation of turbulent velocity fields: averages, moments, correlations, length and time scales and the energy cascade. Averaged equations of motion, closure requirements, Reynolds stress, dissipation rate. Isotropic turbulence, homogeneous shear flows, free shear flows, wall bounded flows. Scalar transport, particulate transport.

Aer E 573. Random Signal Analysis and Kalman Filtering. (Same as E E 573, Math 573, M E 573.) (3-0) Cr. 3. F. *Prereq:* 331 or E E 321 or M E 370 or 411 or Math 341 or 395. Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

Aer E 574. Optimal Control. (Same as E E 574, Math 574, M E 574.) (3-0) Cr. 3. *Prereq:* 577. The optimal control problem. Variational approach. Pontryagin's principle. Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

Aer E 575. Introduction to Robust Control. (Same as E E 575, Math 575, M E 575.) (3-0) Cr. 3. *Prereq:* 577. Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H₂, H_∞, and I1 control problems. Tools for robustness analysis and synthesis.

Aer E 576. Digital Feedback Control Systems. (Same as E E 576, Math 576, M E 576.) (3-0) Cr. 3. *Prereq:* 432 or E E 475 or M E 411 or 414 or Math 415; and Math 267. Sampled data, discrete data, and the z-transform. Design of digital control systems using transform methods; root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

Aer E 577. Modern Control Systems I. (Same as E E 577, Math 577, M E 577.) (3-0) Cr. 3. F. *Prereq:* 331 or E E 321 or M E 414 or Math 415; and Math 307. State variable and input-output descriptions of linear continuous-time and discrete time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems. Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical form dynamical equations. State feedback. State estimators. Decoupling by state feedback. Design of feedback systems. Stability of linear dynamical systems.

Aer E 578. Modern Control Systems II. (Same as E E 578, Math 578, M E 578.) (3-0) Cr. 3. S. *Prereq:* 577. Well-posedness of nonlinear control systems. Approximate analysis methods. Poincaré perturbation method and describing function method. Lyapunov stability theory. Absolute stability of feedback systems. Input-output stability. Large-scale systems.

Aer E 579. Adaptive Control. (Same as E E 579, Math 579, M E 579.) (3-0) Cr. 3. *Prereq:* 577. Fundamentals of adaptive control; terminology, parameter identification, basic adaptive controller design techniques, analysis of stability, parameter convergence, and robustness. Nonlinear adaptive control. Application examples.

Aer E 590. Special Topics. Cr. 1 to 5.

- A. Aero and/or Gas Dynamics
- B. Propulsion
- C. Aerospace Structures
- D. Flight Mechanics
- E. Spacecraft Systems
- F. Flight Control Systems
- G. Aeroelasticity
- H. Viscous Aerodynamics
- I. Design
- J. Hypersonics
- K. Computational Aerodynamics
- L. Optimization.

Aer E 599. Creative Component. Cr. 1 to 5.

Courses for Graduate Students

Aer E 620. Seminar. (1-0) Cr. 1.

Aer E 631. Modern Flight Control Systems. (3-0) Cr. 3. F. *Prereq:* 578. Applications of modern control theory to flight control. Controller design based on optimal control techniques. Nonlinear system theory applications. Typical aerospace control methods such as model following, load alleviation, and flutter suppression. Recent advances in aerospace vehicle control.

Aer E 635. Optimization in Aerospace Engineering I. (3-0) Cr. 3. *Prereq:* 531, 541, 551. Applications of unconstrained and constrained parameter optimization, dynamic programming, and optimal control theory to problems in aerodynamics, aerospace structures, flight dynamics and control, and aerospace design. Special emphasis on numerical methods of optimization.

Aer E 636. Optimization in Aerospace Engineering II. (3-0) Cr. 3. *Prereq:* 635. Applications

of unconstrained and constrained parameter optimization, dynamic programming, and optimal control theory to problems in aerodynamics, aerospace structures, flight dynamics and control, and aerospace design. Special emphasis on numerical methods of optimization.

Aer E 641. Hypersonic Gas Dynamics. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 542. High Mach number flows, Newtonian theory, small disturbance theory, constant density solutions, thin shock layers, blunt body problems, hypersonic boundary layers and viscous interactions, thermally and calorically imperfect gases, vibrational relaxing and chemically reacting flows.

Aer E 646. Computational Methods for Internal and Low Speed Flows. (Same as M E 646.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 547. Emphasis is on algorithms suitable for low speed and internal flows at speeds up through transonic. Topics include pressure-based schemes, pseudo-compressibility methods, use of preconditioning to develop algorithms suitable for all speed regimes, large eddy simulations, algorithms for unstructured grids, and finite elements in fluids.

Aer E 647. Advanced High Speed Computational Fluid Dynamics. (Same as M E 647.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 547. An examination of current methods in computational fluid dynamics. Differencing strategies. Advanced solution algorithms. Grid generation. Construction of complex CFD algorithms. Current applications. Use of state of the art CFD codes.

Aer E 650. Fluid Mechanics Seminar. (Same as M E 650.) (1-0) Cr. 1 each time taken. F. *Prereq:* Permission of instructor. Special topics of current research interest to students and staff of departments concerned.

Aer E 651. Orbit Computation, Estimation and Analysis. (3-0) Cr. 3. S. *Prereq:* 551. Hamiltonian and Lagrangian formulations. Properties of orbits. Methods of numerical and analytical computation. Orbit determination and parameter estimation. Applications to astrodynamics and celestial mechanics.

Aer E 661. Perturbation Methods. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* Math 267. Mathematical perturbation methods with applications to ordinary differential equations. Perturbation expansions. Order of magnitude and gauge functions. Matched asymptotic expansions. Boundary layer problems. Multiple scales. Resonance and mode coupling. Solvability conditions for differential equations. Physical and engineering applications.

Aer E 662. Viscous Flow Asymptotic Theory. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 661, 541. 1st and 2nd order boundary-layer theory. Coordinate expansions. Triple-deck theory. Compressible boundary layers. Two and three-dimensional, steady and unsteady flow separation. Internal and external flows. Wave-packet propagation in unsteady flows.

Aer E 690. Advanced Topics. Cr. 1 to 5.

- A. Aero and/or Gas Dynamics
- B. Propulsion
- C. Aerospace Structures
- D. Flight Mechanics
- E. Spacecraft Systems
- F. Flight Control Systems
- G. Aeroelasticity
- H. Viscous Aerodynamics
- I. Design
- J. Hypersonics
- K. Computational Aerodynamics

Aer E 699. Research.

African American Studies

(Interdepartmental Undergraduate Program)

Program Committee: D. Anderson, R. Baum,

J. Berry, Herman Blake, G. Cornelius,
M. DeRadcliffe, J. Davis, Shirley Dunlap,
K. Hickok, D. Sardine, G. Tartakov

Undergraduate Study

African American Studies, a cross-disciplinary program in the College of Liberal Arts and Sciences, offers an opportunity to explore African Americans' contributions to American culture. Analysis of the African American experience—in history, literature, art, religion, and society—provides students with skills, sensitivities, and information to help them function more effectively in today's diverse society.

African American Studies at Iowa State University is an expanding program. Most of the courses in the program satisfy general education requirements in the College of Liberal Arts and Sciences, the human relations requirement for teachers, and the university's diversity requirement. At present students can minor or even design their own Interdisciplinary Studies major with an emphasis in African American Studies.

A minor in African American Studies requires five courses in the program with a minimum of 15 credits, including Introduction to African American Studies (Af Am 201). The remaining credits must come from at least two departments, with at least two courses taken at the junior level or above. Independent study and internship opportunities are available for credit, but do not count in the minimum requirements for the minor.

Graduate Study

Courses open for nonmajor graduate credit: 334, 347, 348, 349, 350, 465.

Courses Primarily for Undergraduate Students

Af Am 201. Introduction to African American Studies. (3-0) Cr. 3. F. S. An interdisciplinary introduction to the study of African American culture. Includes history, the social sciences, literature, religion, and the arts, as well as conceptual frameworks for investigation and analysis of the African American experience.

Af Am 252. African American Theatre Production. (Same as Thtr 252.) See *Theatre*.

Af Am 310. Introduction to African History I. (Same as Hist 310.) See *History*.

Af Am 311. Introduction to African History II. (Same as Hist 311.) See *History*.

Af Am 325. Peoples and Cultures of Africa. (Same as Anthr 325.) See *Anthropology*.

Af Am 330. Ethnic and Race Relations. (Same as Soc 330.) See *Sociology*.

Af Am 333. African American Ethnology. (Same as Anthr 333.) See *Anthropology*.

Af Am 334. African American Religious Experience. (Same as Relig 334.) See *Religious Studies*. Nonmajor graduate credit.

Af Am 347. Survey of African American Literature. (Same as Engl 347.) See *English*. Nonmajor graduate credit.

Af Am 348. Contemporary African American Literature. (Same as Engl 348.) See *English*. Nonmajor graduate credit.

Af Am 349. Selected Topics in Minority Literatures of the United States. (Same as Engl

349.) See *English*. Available only when offered as a course in African American literature. Nonmajor graduate credit.

Af Am 350. African American Women. (Same as W S 350.) See *Women's Studies*. Nonmajor graduate credit.

Af Am 353. History of African Americans I. (Same as Hist 353.) See *History*.

Af Am 354. History of African Americans II. (Same as Hist 354.) See *History*.

Af Am 381. Survey of Black American Music. (Same as Music 381.) See *Music*.

Af Am 465. Seminar: Religion in Global Context. (Same as Relig 465.) See *Religious Studies*. When content is appropriate, may be taken as Relig 465. Nonmajor graduate credit.

Af Am 490. Independent Study. Cr. 1 to 3 each time taken, maximum of 3. *Prereq:* 6 credits in *African American Studies*, and permission of instructor and of the chair of the *African American Studies Program*.

Agricultural Education and Studies

Robert A. Martin, Chair of Department

Professors: Carter, Crawford, Martin, Miller, Williams

Professors (Emeritus): Gamon, Gauger, Hoerner, Lawrence, Parsons

Associate Professors: Acker, Bogue, Honeyman, Jones, Miller, Trede

Assistant Professors: Morris, Polito

Assistant Professors (Adjunct): Brown

Undergraduate Study

For undergraduate curricula in agricultural education, agricultural extension education, agricultural studies, and professional agriculture (off campus) leading to the degree bachelor of science, see *College of Agriculture, Curricula*.

The department offers four curricula for students desiring to enter careers in agriculture and related fields. These curricula are agricultural education, agricultural extension, agricultural studies, and professional agriculture (off campus). The agricultural education curriculum prepares persons for careers as agricultural education instructors and educational specialists for industry and governmental agencies. The agricultural education curriculum has two options, teacher certification and communication. The agricultural extension education curriculum prepares persons for careers in extension. The agricultural studies curriculum prepares persons for careers in production agriculture and agricultural industry. The professional agriculture curriculum is an off-campus program that prepares persons for careers in production agricultural industry. Graduates of each curriculum accept positions in agricultural business, industry, agencies, and production agriculture.

Graduates are able to communicate effectively. They have a broad base of agricultural knowledge. They have the ability to live and

work in a global society and have an understanding of today's technical society. They are skilled in making decisions and have the ability to plan, organize, present, and evaluate information.

The department offers a minor in agricultural education which may be earned by completion of a minimum of 15 credits in agricultural education and studies courses, with a minimum of two courses at the 400 level. Courses that can be taken for a minor are 211, 310, 311, 315, 411, 412 or 418, 414, 450, 490, 496, and 499.

Visit our departmental website at <http://www.ag.iastate.edu/departments/aged/>

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with a major in agricultural education, a specialization in agricultural extension education, opportunities for emphasis in international agricultural education, and minor work to students majoring in other curricula. Graduate students who have earned a bachelor's degree in an agricultural discipline may plan a course of study that leads to teacher certification. Candidates pursuing the master of science degree may do so by completing either a thesis or nonthesis program of study.

Graduates have abilities in delivery systems, learning theories and principles, formative and summative evaluation, philosophic models, qualitative and quantitative research, organizational leadership, policy development, assessing educational need, organizing educational programs, and developing international agricultural education programs.

The department administers the interdepartmental graduate program in professional agriculture designed for off-campus students pursuing a master of agriculture degree; see *Off-Campus Credit Courses and Programs*.

The department also cooperates in the international development studies option of the General Graduate Studies Program.

Courses and workshops are offered, both on and off campus, for extension educators, agricultural education educators, teachers, and industry personnel.

Courses open to students for nonmajor graduate credit: 410, 411, 412, 414, 417, 418, 450, 496.

Courses Primarily for Undergraduate Students

AgEds 110. Orientation. (1-0) Cr. 0.5. F. Orientation to the department. Careers in agriculture.

- A. Agricultural Education
- B. Agricultural Studies
- C. General Agriculture

AgEds 111. Orientation for Agricultural Excellence Scholars. (1-0) Cr. 1 each time taken, maximum of 2 credits. F. *Prereq:* Enrollment as an agricultural excellence scholar. The roles of professionals in agriculture, academic preparation for assuming the role of a professional in agriculture, and meeting the demands of the scholar's curriculum.

AgEds 112. Agriculture Biotechnology Colloquium. (1-0) Cr. 1. S. *Prereq:* Enrollment as an

agricultural excellence scholar. The scientific basis of biological and social sciences in agriculture.

AgEds 211. Early Field Based Experience. (1-0) Cr. 1 each time taken, maximum of 3 credits. F.S.SS. *Prereq: 110.* Five days on-site in an agricultural setting plus orientation and follow-up sessions. Participation and observation at approved sites under supervision by a professional. Site options are high schools, Extension, agricultural agencies and industries. Provides career guidance, role model, and set of activities for reference in future courses. Experience needs to be completed before students enroll in the course. This course is a prerequisite to all 400 level internships in agricultural education.

AgEds 215. Career Seminar. (1-0) Cr. 1. F.S. *Prereq: Sophomore classification.* Overview of career opportunities. Evaluation interests and accomplishments and setting career goals. Development of job search and interviewing skills. Establishing networks of job contacts.

AgEds 290. Special Problems in Agricultural Education and Studies. Cr. 1-3 each time taken, maximum of 6. F.S.SS.

AgEds 310. Foundations of Agricultural Education Programs. (2-0) Cr. 2. F.S. Historical development of agricultural education programs. Philosophic premises, program goals and objectives. Educational and social issues impacting the implementation of agricultural education programs.

AgEds 311. Presentation and Sales Strategies for Agricultural Audiences. (3-0) Cr. 3. F.S. Utilizing instructional methods, techniques, and problem solving, presentation and sales strategies with agricultural audiences.

AgEds 315. Leadership Programs in Agriculture. (3-0) Cr. 3. F.S. Principles and practices in planning, developing, conducting, and evaluating leadership programs for agricultural groups.

AgEds 410. Planning Agricultural Education Programs. (3-0) Cr. 3. F. *Prereq: 310.* Responsibility of an agricultural education teacher, curriculum development, experiential learning opportunities including FFA and SAE, and assessment and maintenance of program quality. Nonmajor graduate credit.

AgEds 411. Methods of Teaching in Agricultural Sciences/Agribusiness. (3-0) Cr. 3. S. *Prereq: 410.* Topics include: principles of teaching and learning, individualized and group methods, application of learning, instructional management, special populations, and evaluation. Nonmajor graduate credit.

AgEds 412. Internship in Agricultural Education and Studies. 2 to 12 weeks. Cr. 2 to 6 each time taken, maximum of 6. F.S.SS. *Prereq: 211, junior classification in AGEDS and permission of instructor.* A supervised learning experience in an approved learning setting with application to educational, agricultural and/or environmental practices and principles. Nonmajor graduate credit.

AgEds 414. Developing Agricultural Education Programs in Non-Formal Settings. (2-0) Cr. 2. S. *Prereq: 211 and permission of instructor.* Basic concepts in planning, conducting, and evaluating educational programs in non-formal settings. Includes programming for youth and adults in Extension, agricultural industry, and related agencies. Nonmajor graduate credit.

AgEds 416. Pre-Student Teaching Experience in Agricultural Education. Cr. 1. F.S. *Prereq: 411 and admission to teacher education program.* A one-week field-based experience in an approved secondary agricultural education program. Concurrent enrollment in 417 is required. Nonmajor graduate credit.

AgEds 417. Supervised Teaching in Agricultural Education Programs. Cr. 12. F.S. *Prereq: 411 and admission to teacher education program.* Supervised teaching in public schools. Nonmajor graduate credit.

AgEds 418. Supervised Extension Experience. Cr. 2 to 8. May be repeated to a maximum of 16 credits. F.S.SS. *Prereq: 211, junior classification, permission of instructor.* Supervised professional experience in an approved county, area or state Cooperative Extension Service office. Nonmajor graduate credit.

AgEds 450. Farm Management and Operation. (1-6) Cr. 3. F.S.SS. *Prereq: Econ 135, Econ 330, junior classification.* Participation in the management and operation of a diversified Iowa farm. The class is responsible for the plans, records, and decisions for buying and selling the farm's livestock, crops, and equipment. Special speakers on current topics. May be taken for credit 3 times at different times of the year by permission of the instructor. Nonmajor graduate credit.

AgEds 490. Independent Study in Agricultural Education and Studies. Cr. 1 to 3. F.S.SS. *Prereq: Junior or senior classification, permission of instructor.* A maximum of 6 credits of 490 may be used toward the total of 128 credits required for graduation.

- A. Philosophy, Curriculum, and Methods
- B. Leadership, Evaluation, and Administration
- C. Business, Industry, and Production Agriculture
- D. Extension and International Agriculture
- E. Instructional Technology
- F. Environmental Issues
- H. Honors
- I. Communications

AgEds 496. Agricultural Travel Course. Cr. 1 to 3. F.S.SS. *Prereq: Permission of instructor.* Study and tour of agricultural industries, climate, crops, culture, economics, geography, history, livestock, marketing, and soils of host country. Nonmajor graduate credit.

AgEds 499. Undergraduate Research. Cr. arr. F.S.SS. *Prereq: Permission of instructor, adviser, and departmental executive officer.* Research experience in agricultural education and studies with application to selected problems.

Courses Primarily for Graduate Students, open to qualified undergraduate students

AgEds 500. Short Course in Agricultural Education. Cr. 1 to 3 each time taken. F.S.SS. *Prereq: Permission of instructor.* Specific problems, issues, and content areas in agricultural education. On and off campus on arranged basis. Materials fee.

AgEds 510. Applied Research Methodology in Agricultural Education. (3-0) Cr. 3. F. *Prereq: Permission of instructor.* Designing, conducting, and consuming research in agricultural education and related areas. Topics include issues related to research, quantitative and qualitative design, sampling, writing research prospecti, reviewing literature, and becoming consumers of research.

AgEds 511. Instructional and Organizational Issues for Beginning Teachers of Agriculture Programs. Cr. 1 to 2. F. *Prereq: Permission of instructor.* Planning and conducting agricultural programs in secondary schools.

AgEds 514. Organizing Agricultural Information for Professional and Scientific Meetings. (1-2) Cr. 2. F.S. *Prereq: Graduate classification in agriculture.* Concepts and practices in planning, preparing, and presenting materials used in professional meetings and scientific papers by agriculturalists with special emphasis on computerized delivery methods. Materials fee.

AgEds 520. Instructional Methods for Teaching in Agricultural Education. (3-0) Cr. 3. F. *Prereq: Permission of instructor.* Preparation of graduate students to become college or university instructors. Addresses the principles of teaching and learning as they influence teaching activities; psychological aspects of learning, developing teaching plans; laboratory teaching; evaluating student learning; motivating students; examining personal teaching behaviors that influence learning, and choosing appropriate teaching methods.

AgEds 521. Leadership Development in Agricultural Education. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: Permission of instructor.* Principles and practices of leadership and group dynamics. Designing, organizing, implementing, and evaluating leadership programs for developing exemplary leaders of agricultural teams and groups.

AgEds 524. Program Development and Evaluation in Agricultural Extension Education. (3-0) Cr. 3. Alt.

S., offered 2000. *Prereq: Permission of instructor.* Development of program objectives, implementation strategies and evaluation procedures based on agricultural needs and educational opportunities in communities, counties, and multi-county areas.

AgEds 530. Distance Teaching and Learning in Agriculture. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: Permission of instructor.* Understanding distance learners in agriculture and their educational needs and preferences. Technology options to enhance distance teaching. Methods of teaching at a distance and administrative issues.

AgEds 538. Adult and Post-Secondary Education in Agriculture. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: Permission of instructor.* Theory and practice of adult learning and the delivery of formal and non-formal programming for agriculturally related audiences. Why and how adults learn differently than children. Leading instruction from the point of learners first. Reviews thinking, whole brain concepts, domains, styles, and levels of learning.

AgEds 560. Role of Agricultural Education and Agricultural Extension in Technology Transfer. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: Permission of instructor.* Processes by which formal and informal Extension and other agricultural education programs influence introduction and acceptance of agricultural technology, including strategies for technology transfer.

AgEds 561. Agricultural and Extension Education in Developing Countries. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: Permission of instructor.* Utilizing systematic approaches to identifying, analyzing, and solving problems in international agricultural education, with emphasis on the impact of agricultural education, formal and nonformal, on development.

AgEds 590. Special Topics in Agricultural Education. Cr. 1 to 3. F.S.SS. *Prereq: 12 credits in agricultural education.*

- A. Curriculum
- B. Methods
- C. Philosophy
- D. Evaluation
- E. Administration
- F. Leadership
- G. Guidance
- I. Instructional Technology
- J. Extension
- K. International Agriculture
- L. Program Planning

AgEds 593. Workshop in Agricultural Education. Cr. 1 to 3 each time taken. F.S.SS. *Prereq: 12 credits in agricultural education.* Materials fee.

- A. Curriculum
- B. Methods
- C. Evaluation
- D. Administration
- E. Leadership
- F. Extension
- G. Program Planning
- H. Instructional Technology
- M. Biotechnology Workshop

AgEds 599. Creative Component. F.S.SS. For non-thesis M.S. degree programs.

Courses for Graduate Students

AgEds 604. Evaluation in Agricultural Education. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: 410 or 524 and permission of instructor.* Criteria and procedures for designing evaluations of programs in agricultural education. Critique of evaluation theories. Selection and construction of evaluation instruments. Reporting of results and recommendations.

AgEds 610. Curriculum Development in Agricultural Education. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: 410 and permission of instructor.* Analysis of social, individual, and subject matter needs in agriculture and their impact on agricultural curricula. Application of new concepts and educational theory to curriculum planning in agricultural education.

AgEds 615. Seminar in Agricultural Education. (1-0) Cr. 1 each time taken. F.S.SS. Offered on a satisfactory-fail grading basis only.

AgEds 617. Professional Internship for Agricultural Educators. Cr. 1-3 each time taken, maximum of 3. F.S.SS. *Prereq:* *Permission of instructor.* Analysis of the roles and activities of professionals in agricultural education. Supervised professional field-based experience in public and private settings.

AgEds 620. Research Procedures in Agricultural Education. (3-0) Cr. 3. S. *Prereq:* *510 and a course in statistics.* Application of research methods to agricultural education research. Identification of research priorities, developing research design and data analysis procedures, and critique of research in agricultural education.

AgEds 625. Administration and Supervision of Agricultural Education Programs. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* *521.* Management principles and practices of planning, organizing, directing, staffing, and evaluating as applied to administration and supervision of programs in agricultural education.

AgEds 630. Philosophy and Policymaking in Agricultural Education. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* *Permission of instructor.* Basic philosophical premises in development of agricultural education programs. The role of philosophy in policymaking. Social and educational issues impacting philosophy and policymaking in agricultural education.

AgEds 699. Research.

Agricultural Engineering

(Administered by the Department of Agricultural and Biosystems Engineering)

Stewart Melvin, Head of Department

Undergraduate Study

For the undergraduate curriculum in agricultural engineering leading to the degree bachelor of science, see *College of Engineering, Curricula*. This curriculum is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

The goal of the academic program in agricultural engineering is to train men and women to integrate basic biological and physical sciences through application of engineering fundamentals and design to biological systems involved in production, processing, storage, handling, distribution, and use of food and other biomaterials, and in managing related natural resources worldwide.

The objective of the academic program in agricultural engineering is to produce graduates who should have:

1. an ability to apply knowledge of mathematics, science, and engineering in solving engineering problems.
2. an ability to design and conduct experiments, and to analyze and interpret experimental data.
3. an ability to design a system, component, or process as needed for agricultural or biological systems.
4. an ability to function on multi-disciplinary teams.
5. an ability to identify, formulate, and solve engineering problems related to production, processing, storage, handling, distribution, and use of food and other biological products worldwide, and the responsible management of the environment and natural resources.

6. an understanding of professional and ethical responsibility.
7. an ability to use the techniques, skills, and engineering tools needed for engineering practice.
8. a recognition of the need for, and an ability to engage in, life-long learning.
9. an ability to communicate effectively.
10. the knowledge to understand impacts of engineering solutions locally, nationally, and globally.
11. a knowledge of important contemporary issues.
12. a breadth and depth of knowledge in social sciences and humanities needed to function effectively in society.
13. proficiency in mathematics through differential equations and engineering sciences relevant to agricultural engineering and a chosen option area.
14. a demonstrated knowledge of agricultural and/or biological sciences, and natural resource topics appropriate for a chosen option area.
15. a demonstrated competency in fields among the following which are appropriate for a chosen option area: biological materials, biological systems, computer and automatic control systems, information systems, machine systems, natural resource and environmental systems, process control systems, heat and mass transfer systems, and structural design.
16. experience in agricultural engineering practice through co-ops or internships in industry, government agencies, or research groups.

Graduates find employment in diverse ag- and bio-related industries and government agencies and work in engineering design, development, testing, research, manufacturing, consulting, sales, and service. Professional engineering services are performed in the agricultural equipment industries, building and environmental control companies, grain processing and handling firms, soil and water resource agencies and biotechnology companies.

Food industry employment is related to production of food products. Food and process engineers design, develop, implement, and evaluate food processing procedures and systems.

The department has cooperative programs established for interested and qualified students. The four-year curriculum is extended over a five-year period and interspersed with work periods at cooperating organizations. This plan offers valuable practical experience and financial assistance during the years in college.

The department offers an undergraduate curriculum and courses in agricultural systems technology, see *College of Agriculture, Curricula*.

Graduate Study

The department offers work for the degrees master of science, master of engineering, and doctor of philosophy with major in agricultural engineering and minor work to students taking major work in other departments. Within the major the student may specialize in soil and water resources, agricultural power and machinery, food and process engineering,

biosystems engineering, or agricultural structures and environmental systems engineering. Minor work is also offered in agricultural systems technology for students in other graduate majors. See *Agricultural Systems Technology*.

Prerequisite to major graduate work is the completion of an undergraduate curriculum substantially equivalent to that required of agricultural engineering undergraduate students at this institution. However, because of the diversity of interests within the graduate programs in agricultural engineering, a student may qualify for graduate study even though the undergraduate training has been in a discipline other than engineering. Supporting work will be required depending on the student's background and area of interest with requirements defined by departmental guidelines.

For the master of science program at least 30 credits of acceptable graduate work must be completed with a minimum of 22 credits of course work; corresponding numbers for the master of engineering program are 31 and 27. For the degree doctor of philosophy, the corresponding numbers are 72 and 49; plus an additional 6 hours of coursework are required as an "enrichment component" in some important subject area apart from the major, minor, or other principle thrust area. All graduate students are also expected to have some teaching/extension experience.

The department also participates in the inter-departmental majors in water resources and toxicology (see *Index*).

Courses open for nonmajor graduate credit: 342, 363, 372, 409, 413, 422, 445, 446, 447, 478.

Courses Primarily for Undergraduate Students

A E 110. Experiencing Agricultural and Biosystems Engineering. (0-3) Cr. 1. F.S. Laboratory-based, team-oriented experiences in a spectrum of topics common to the practice of agricultural and biosystems engineering. Report writing, co-ops, internships, careers. Materials fee, field trip fee.

A E 215. Fundamentals of Agricultural and Biosystems Engineering I. (2-2) Cr. 3. F. *Prereq:* *A E 110, Engr 160 or 161, credit or enrollment in Math 166.* Application of mathematics and engineering sciences to energy and mass balances in agricultural and biological systems. Emphasis is on solving engineering problems in the areas of air and water vapor systems; machine systems; food systems; and grain processing. Materials fee, field trip fee.

A E 216. Fundamentals of Agricultural and Biosystems Engineering II. (2-2) Cr. 3. S. *Prereq:* *A E 110, Engr 160 or 161, credit or enrollment in Math 166.* Application of mathematics and engineering sciences to energy and mass balances in agricultural and biological systems. Emphasis is on solving engineering problems in the areas of hydrologic systems; electrical systems; and mass and energy transport in cells and microbes. Materials fee.

A E 271. Engineering Applications of AutoCAD. (1-2) Cr. 1. 8 weeks. F.S. *Prereq:* *Engr 160 or 161.* Creating, editing, organizing, and documenting two-dimensional and three-dimensional geometries with AutoCAD.

A E 272. Parametric Solid Models, Drawings, and Assemblies Using Pro/ENGINEER. (0-4) Cr. 1. 8 weeks. F.S. *Prereq:* *271.* Application of the Pro/ENGINEER software to create 3D solid models of parts and assemblies. Utilizing the solid models to create

design documentation: standard drawing views, dimensions, and notes.

A E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; sophomore classification.* Required of all cooperative students. Students must register for this course prior to commencing each work period.

A E 303. Computer Applications and Systems Modeling. (2-2) Cr. 3. F. *Prereq: Engr 160, Stat 305, Math 166.* Computer aided solution of agricultural engineering problems by use of numerical techniques and mathematical models. Systems analysis and optimization applicable to agricultural and biological systems.

A E 342. Agricultural Tractor Power. (2-3) Cr. 3. S. *Prereq: M E 330.* Thermodynamic principles and construction of tractor engines. Fuels, combustion, and lubrication. Kinematics and dynamics of tractor power applications; drawbar, power take-off and traction mechanisms. Field trip fee. Nonmajor graduate credit.

A E 363. Agri-Industrial Applications of Electric Power and Electronics. (2-2) Cr. 3. F. *Prereq: Phys 222.* Single phase and three phase circuit design. Electrical safety. Electric motors and controls. Programmable logic controllers. Process control. Materials fee. Nonmajor graduate credit.

A E 372. Heat Transfer in Environmental Systems. (3-0) Cr. 3. S. *Prereq: 215, M E 330.* Programming proficiency. Solution of practical heat transfer problems involving conduction, convection, and radiation applied to biological and environmental systems. Numerical techniques for solving multi-dimensional steady-state and transient heat transfer problems. Nonmajor graduate credit.

A E 396. Summer Internship for International Students. Cr. R. SS. *Prereq: Permission of department.* Summer professional work period for international students.

A E 397. Engineering Internship. Cr. R. F.S. *Prereq: Permission of department.* One semester maximum per academic year professional work period.

A E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; junior classification.* Required of all cooperative students. Students must register for this course prior to commencing each work period.

A E 401. Senior Seminar. (1-0) Cr. R. F. *Prereq: Senior classification.* Preparation and presentation of papers on agricultural engineering subjects. Discussion of engineering ethics and professionalism. Career development.

A E 404. Instrumentation for Agricultural and Biosystems Engineering. (Dual-listed with 504.) (2-2) Cr. 3. F. *Prereq: 363 or Cpr E 210 or E E 441.* Interfacing techniques for computer-based data acquisition and control systems. Basic interfacing components including A/D and D/A conversion, signal filtering, multiplexing, and process control. Sensors and theory of operation applied to practical monitoring and control problems. Materials fee.

A E 409. Engineering Quantification of Biological Processes. (2-2) Cr. 3. S. *Prereq: Math 266; Biol 109 or 201 or 202; M E 330.* Development of models to quantify response of biological systems to environmental conditions. Bioenergetics, thermodynamics, enzyme kinetics, metabolism, bioregulation, mechanical processes applied to plant, animal, and microbial systems. Materials fee. Nonmajor graduate credit.

A E 413. Practical Fluid Power Circuits. (Same as M E 413.) (0-3) Cr. 1. F. *Prereq: Credit or enrollment in 447 or M E 414.* Properties of fluids. Pump and motor efficiencies. Analysis and assembly of fluid power systems and experimental investigation of appropriate control systems. Application to hydrostatic transmissions. Field trip fee. Nonmajor graduate credit.

A E 422. Natural Resource Conservation Engineering. (2-3) Cr. 3. F. *Prereq: 216, E M 378 or Ch E 356.* Planning and design of systems to conserve and utilize natural resources in the agricultural environment. Small watershed hydrology, water movement and utilization in the soil-plant-atmos-

phere system, agricultural water management, best management practices for control of erosion, and agricultural water quality. Nonmajor graduate credit.

A E 445. Agricultural Engineering Design I. (1-0) Cr. 1. F. *Prereq: A E 271, E M 324.* Identification of current design problems in agricultural engineering. Development of alternate solutions using creativity and engineering analysis and synthesis techniques. Nonmajor graduate credit.

A E 446. Agricultural Engineering Design II. (1-4) Cr. 3. S. *Prereq: 445.* Selection of promising solutions to design problems identified in 445 for development by design teams. Presentation of designs through oral and written reports and prototypes. Nonmajor graduate credit.

A E 447. Power and Control Hydraulics (2-0) Cr. 2. F. *Prereq: Credit or enrollment in E M 378 or M E 335.* Properties of hydraulic fluids. Performance parameters of fixed and variable displacement pumps and motors. Characteristics of control valves. Analysis and design of hydraulic systems for power and control functions. Nonmajor graduate credit.

A E 451. Food Process Engineering. (Dual-listed with 551.) (2-3) Cr. 3. S. *Prereq: 372 or Ch E 357.* Application of momentum, heat, and mass transfer in food processing. Analysis of selected unit operations used in food processing. Extrusion, dehydration, thermal processing. Field trip fee, materials fee.

A E 465. Physical Properties of Biological Materials. (Dual-listed with 565.) (2-2) Cr. 3. F. *Prereq: 215.* Properties of agricultural and food materials needed in design, application, and evaluation of unit operations used in processing biological materials into finished products. Rheological, thermal, viscoelastic, hygroscopic, aerodynamic, and mechanical properties. Materials fee.

A E 466. Multidisciplinary Engineering Design. (Same as Cpr E 466, E E 466, E Sci 466, I E 466, M E 466, Mat E 466.) (1-4) Cr. 3. F.S. *Prereq: Student must be within two semesters of graduation and receive permission of the instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentation, and computer models and engineering drawings.

A E 469. Grain Processing and Handling. (Dual-listed with 569.) (2-3) Cr. 3. S. *Prereq: 215.* Cereal grain and oilseed properties, quality measurement, processing, and end-use value. Design of drying systems using computer simulation. Corn wet and dry milling. Soybean oil extraction. Grain handling systems. Field trip fee, materials fee.

A E 471. Timber Design for Agricultural Structures. (Dual-listed with 571.) (1-2) Cr. 2. Alt. S., offered 2000. *Prereq: 478.* Design of timber beams, columns, and fasteners. Plywood design. Analysis of timber structures by diaphragm action and matrix analysis. Post-frame building design. Design with composite materials.

A E 472. Design of Environmental Systems for Agricultural Structures. (Dual-listed with 572.) (2-2) Cr. 3. Alt. S., offered 2001. *Prereq: 215, 372, M E 330.* Principles and design of animal environmental systems. Animal responses to environmental modification. Insulation, heat transfer, ventilation, air jets, air distribution, heating and cooling equipment, and controls. Analysis of air quality. Research instrumentation. Bio-imaging.

A E 473. Environmental Bioprocessing of Agricultural Byproducts. (Dual-listed with 573.) (3-0) Cr. 3. S. *Prereq: Chem 167, Ch E 356 or E M 378.* Principles of chemistry, microbiology, and engineering applied to design of systems for treatment and utilization of livestock manures and other agricultural byproducts. Bioenergetics of microbial processes. Composting agricultural wastes. Odor measurement, modeling, and control.

A E 478. Design of Agricultural Structures. (2-2) Cr. 3. S. *Prereq: 271, E M 324.* Uniform Building Code and ANSI Standard. Analysis of wind, snow, dead and live loads. Pressures from granular materials. Design of light-framed agricultural structures using cold-formed steel. Flexural and compression members, connections. Application to grain bins, agricultural buildings, and equipment. Finite element analysis. Nonmajor graduate credit.

A E 490. Independent Study. Cr. 1 to 4.
B. Biosystems Engineering
C. Computer-aided Design
E. Environmental Systems
F. Food Engineering
H. Honors
P. Power and Machinery
Q. Structures
R. Process Engineering
S. Environmental and Natural Resources Systems
U. Waste Management

A E 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; senior classification.* Required of all cooperative students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, open to qualified undergraduate students

A E 502. Simulation of Agricultural Systems. (3-0) Cr. 3. S. *Prereq: One statistics course, one computer programming course, one senior-level agricultural science course.* Model development and computer simulation of processes and systems in agriculture. Model elements include soil, crop, animal, and machine parameters.

A E 503. Controls for Agricultural Systems. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: Math 267, E E 441.* Modeling dynamic systems with ordinary differential equations. Linear differential equations and solution by Laplace transforms. Feedback and stability examined in the s domain. Frequency response as an analytical and experimental tool. Analysis of selected systems from fluid power controls for agricultural equipment. Introduction to state variable methods of system analysis. State variable feedback using pole placement. MATLAB will be used throughout the course for modeling.

A E 504. Instrumentation for Agricultural and Biosystems Engineering. (Dual-listed with 404.) (2-2) Cr. 3. F. *Prereq: 363 or Cpr E 210 or E E 441.* Interfacing techniques for computer-based data acquisition and control systems. Basic interfacing components including A/D and D/A conversion, signal filtering, multiplexing, and process control. Sensors and theory of operation applied to practical monitoring and control problems. Individual and group projects required for graduate credit. Materials fee.

A E 510. Applied Crop Growth Modeling. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: Math 165, Bot 320, Com S 205 or equivalent.* Development of mathematical models and simulation techniques to describe physiological processes of crop growth including phenological development, biomass accumulation (vegetative and reproductive), water and nutrient uptake, and effects of biotic and abiotic stress. Evaluation of existing models. Criteria for selecting models.

A E 520. Agricultural Water Quality Engineering. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: Chem 163 or 167, Agron 154 or Geol 201, AST 324 or Agron 402 or C E 372.* Physical and chemical properties and processes that affect the transport and fate of chemicals that occur in crop and livestock production. Methods of measurement of chemical concentrations and loadings on the environment. Modeling of chemical movement and fate. Methods of control of nonpoint pollution in agriculture.

A E 522. Drainage and Irrigation Engineering. (2-3) Cr. 3. Alt. S., offered 2001. *Prereq: 422 or C E 372, Agron 154 or C E 360.* Soil-water-plant relationships; theory of infiltration and evapotranspiration; saturated and unsaturated flow through soils; movement of chemicals in the vadose zone. Design of surface and

subsurface drainage systems; design of sprinkler, trickle, and subsurface irrigation systems. Management of irrigation systems in developing countries.

A E 523. Erosion and Sediment Transport. (3-0) Cr. 3. Alt. F., offered 2001. *Prereq:* 422 or C E 372, Math 266. Erosion processes. Initiation of motion and overland flow. Erosion models. Flow in alluvial channels and theory of transport. Surface soil and channel stability. Wind erosion.

A E 525. Geographic Information Science. (2-3) Cr. 3. Alt. F., offered 2000. *Prereq:* C R P 451. Introduction to geographic information science. Advanced topics in GIS, spatial and non-spatial data acquisition, spatial data structures and algorithms. GIS operations and applications. Decision making in a GIS context. GIS planning and implementation. GIS standard. Global environmental applications. GIS policy, ethical, and legal issues. Multimedia and intelligent GIS. Emerging issues.

A E 551. Food Process Engineering. (Dual-listed with 451.) (2-3) Cr. 3. S. *Prereq:* 372 or Ch E 357. Application of momentum, heat, and mass transfer in food processing. Analysis of selected unit operations used in food processing. Individual and/or group projects required for graduate credit. Field trip fee, materials fee.

A E 565. Physical Properties of Biological Materials. (Dual-listed with 465.) (2-2) Cr. 3. F. *Prereq:* 215. Properties of agricultural and food materials needed in design, application, and evaluation of unit operations used in processing biological materials into finished products. Rheological, thermal, viscoelastic, hygroscopic, aerodynamic, and mechanical properties. Individual and/or group projects required for graduate credit. Materials fee.

A E 569. Grain Processing and Handling. (Dual-listed with 469.) (2-3) Cr. 3. S. *Prereq:* 215. Cereal grain and oilseed preservation, quality measurement, and end-use value. Design of drying systems using computer simulation. Corn wet and dry milling. Soybean oil extraction. Grain handling systems. Individual and group projects required for graduate credit. Field trip fee, materials fee.

A E 571. Timber Design for Agricultural Structures. (Dual-listed with 471.) (1-2) Cr. 2. Alt. S., offered 2000. *Prereq:* 478. Design of timber beams, columns, and fasteners. Plywood design. Analysis of timber structures by diaphragm action and matrix analysis. Post-frame building design. Design with composite materials. Individual and group projects required for graduate credit.

A E 572. Design of Environmental Systems for Agricultural Structures. (Dual-listed with 472.) (2-2) Cr. 3. Alt. S., offered 2001. *Prereq:* 215, 372, M E 330. Principles and design of animal environmental systems. Animal responses to environmental modification. Insulation, heat transfer, ventilation, air jets, air distribution, heating and cooling equipment, and controls. Analysis of air quality. Research instrumentation. Bio-imaging. Individual and group projects required for graduate credit.

A E 573. Environmental Bioprocessing of Agricultural Byproducts. (Dual-listed with 473.) (3-0) Cr. 3. S. *Prereq:* Chem 167, Ch E 356 or E M 378. Principles of chemistry, microbiology, and engineering applied to design of systems for treatment and utilization of livestock manures and other agricultural byproducts. Bioenergetics of microbial processes. Composting agricultural wastes. Odor measurement, modeling, and control. Individual and group projects required for graduate credit. Field trip fee, materials fee.

A E 590. Special Topics. Cr. 1 to 3.
B. Biosystems Engineering
F. Food Engineering
P. Power and Machinery
Q. Structures and Environment
R. Process Engineering
S. Water and Environment
U. Waste Management

A E 598. Technical Paper for Master's Degree. Arr. Cr. 1. F.S.SS. A technical paper draft based on M.S. thesis or creative component is required of all mas-

ter's students. This paper must be in a form that satisfies the requirements of some specific journal and be reviewed and assigned a journal paper number by the Agriculture and Home Economics Experiment Station editor. Offered on a satisfactory-fail grading basis only.

A E 599. Creative Component. Cr. var.

Courses for Graduate Students

A E 661. Seminar. (1-0) Cr. 1. F. Discussion of research problems, methods, procedures, and reports.

A E 690. Advanced Topics. Cr. var.

A E 698. Technical Paper for a Doctoral Degree. Arr. Cr. 1. F.S.SS. A technical paper draft based on dissertation is required of all Ph.D. students. This paper must be in a form that satisfies the requirements of some specific journal and be reviewed and assigned a journal paper number by the Agriculture and Home Economics Experiment Station editor. Offered on a satisfactory-fail grading basis only.

A E 699. Research.
B. Biosystems Engineering
C. Computer-aided Design
E. Environmental Systems
F. Food Engineering
P. Power and Machinery
Q. Structures
R. Process Engineering
S. Environment and Natural Resources
U. Waste Management

Agricultural Systems Technology

(Administered by the Department of Agricultural and Biosystems Engineering)

Stewart Melvin, Head of Department

Professors: Baker, Bekkum, Bern, Bundy, Hurburgh, L. Johnson, Kanwar, Keeney, Mangold, Melvin, Misra, Nikolov

Professors (Adjunct): Quick

Professors (Collaborators): Chu, Colvin, Deboer, Hoffman, Laffen

Distinguished Professors (Emeritus): H. Johnson

Professors (Emeritus): Beer, Bockhop, Buchele, Hazen, Hoerner, Hull, Lovely, Marley, Meyer, Pedersen, Smith

Associate Professors: Anderson, Glanville, Greiner, Harmon, Hoff, Mickelson, Schwab, Tim, Xin

Assistant Professors: Batchelor, Birrell, Lorimor, Richard

Assistant Professors (Adjunct): Shahan

Assistant Professors (Collaborators): Xie

Assistant Professors (Emeritus): Boyd

Instructors (Adjunct): Boyd, Zmolek

Undergraduate Study

The Department of Agricultural and Biosystems Engineering offers the bachelor of science degree with a major in agricultural systems technology (see *College of Agriculture, Curricula*).

The curriculum prepares men and women for careers requiring integration and application of agricultural and mechanical technology, physi-

cal and biological sciences, and business to manage human and natural resources, environmental systems, and systems for producing, processing, and marketing food and other biomaterials worldwide. Graduates have the ability to apply science and technology to problems related to agriculture and manage complex agricultural systems for sustainability. They are able to communicate effectively, have problem-solving skills and awareness of environmental issues. Graduates have developed team building skills and computer proficiency. Graduates find careers with agricultural machinery industries; environmental organizations; governmental agencies; farm builders; grain, feed, seed, fertilizer, and chemical companies; or in production agriculture.

The Department of Agricultural and Biosystems Engineering offers a minor in agricultural systems technology which may be earned by completing a minimum of 15 credits of agricultural systems technology courses, with a maximum of 6 credits of 100- and 200-level courses and at least two credits in 400-level courses. Students may select courses to provide emphasis in areas such as:

1. Machine and energy management,
2. Livestock production systems,
3. Soil and water resource management,
4. Electrical systems,
5. Grain operations
6. Environmental systems technology.

For undergraduate curriculum in agricultural systems technology leading to the degree of bachelor of science, see *College of Agriculture, Curricula*.

Visit our departmental website at <http://www.ae.iastate.edu>

Graduate Study

The Department of Agricultural and Biosystems Engineering offers courses for nonmajor graduate credit in agricultural systems technology for students taking major work in other departments, and cooperates in the interdepartmental program in professional agriculture. A minor in agricultural systems technology is offered.

Courses open for nonmajor graduate credit: 420, 425, 430, 434, 435, 460, 462, 464, 473, 474, 475, 476, 477, 490, 493, 496.

Courses Primarily for Undergraduate Students

AST 110. Orientation in Agricultural Systems Technology. (1-0) Cr. 0.5. F. Orientation to the university, college life and the Agricultural Systems Technology program. Curriculum, employment opportunities, career planning, ethics, internships, work experiences and cooperative education. Resume preparation, interviewing techniques, and portfolio development.

AST 120. Introduction to Renewable Resources. (Same as Agron 120, A Ecl 120, Env S 120, For 120.) (3-0) Cr. 3. F.S. Overview of soil, water, plants, and animals as renewable natural resources in an ecosystems context. History and organization of resource management. Concepts of integrated resource management.

AST 181. Microcomputer Applications in Agriculture. (2-2) Cr. 3. F.S. Microcomputer technology with applications in agriculture. Introduction to computer operation, functions, and operating systems. Operation and application of word processors, spreadsheets, graphics, databases, program integration, e-mail, internet and world wide web access.

Specific agricultural applications including decision aid, accounting, and management programs.

AST 191. Principles of Agricultural Systems Technology. (2-0) Cr. 2. F. *Prereq: Freshman or sophomore classification only.* Introduction to problem solving related to systems in agricultural power and machinery, soil and water conservation, structures and animal environment, and electrical circuits.

AST 233. Energy in Agriculture. (2-0) Cr. 2. F. *Prereq: Sophomore classification.* Basic energy laws, definitions, and units; supply, use, and conservation of conventional fuels in crop and livestock operations and homes; and potential for use of alternative energy sources in agriculture.

AST 260. Using Electric Power. (1-3) Cr. 2. S. *Prereq: Freshman or sophomore classification only.* Basic electricity and electrical safety. Wiring basics for homes and farm buildings. Electric controls and motors. Field trip fee, materials fee.

AST 273. Livestock Buildings and Equipment. (2-0) Cr. 2. S. Effects of thermal environment on livestock. Insulation, ventilation, heating and cooling systems for livestock buildings. Water, feed, and waste handling systems. Planning buildings and equipment for livestock production. Materials fee. Credit may not be applied toward graduation in both 273 and 473.

AST 281. Computer-aided Graphics. (1-4) Cr. 3. F. *Prereq: 181.* Computer-aided graphics for agricultural systems using AutoCAD and other software. Computer-aided drawing and dimensioning of two- and three-dimensional shapes. Attributes, bill of materials, blocks, layers and interfacing with other software. Scanning, slide presentations and electronic clip-art graphics integrated with text.

AST 290. Special Problems. Cr. 1 to 3. *Prereq: Freshman or Sophomore classification, permission of instructor.* A maximum of 6 credits of 290 and 490 may be used toward the total of 128 credits required for graduation.

- A. Animal Environment and Structures
- C. Computer Operations
- E. Electrical/Electronics
- G. Grain Operations
- I. Safety and Human Factors
- K. Bioprocessing
- L. Livestock Production Systems
- M. Machine Systems
- N. Energy
- S. Soil and Water Resources
- T. Structures/Buildings
- W. Waste Management

AST 297. Work Experience in Agricultural Systems Technology. Cr. 1 to 2. F.S.SS. *Prereq: AST major and approval of adviser required prior to commencing work experience.* Work experience must be related to career objectives. Written report and oral presentation required on the work experience. A maximum of 4 credits of 297 may be used toward the total of 128 credits required for graduation.

AST 298. Cooperative Education in Agricultural Systems Technology. Cr. R. F.S.SS. *Prereq: Sophomore classification in AST and approval of cooperative coordinator.* All cooperative education students must register for this course prior to commencing each work period.

AST 324. Soil and Water Conservation Management. (2-0) Cr. 2. F.S. *Prereq: Math 140.* Introduction to engineering principles applied to the planning of erosion control systems, water control structures, water quality management, drainage and irrigation systems, and farm water resource development.

AST 326. Conservation Surveying and Design. (0-3) Cr. 1. F. *Prereq: Credit or enrollment in 324.* Agricultural surveys for field area measurement and mapping. Handbook design of drainage systems and farm water control structures. Layout of conservation structures. Field trip fee.

AST 330. Agricultural Machinery and Power Management. (2-3) Cr. 3. F.S. *Prereq: Math 140, 142.* Selection, sizing, and operational principles of tractors and machinery systems. Cost analysis and computer techniques applied to planning and man-

agement of agricultural machine systems. Principles, operation, and application of power sources.

AST 333. Precision Farming Systems. (2-2) Cr. 3. F. *Prereq: Junior or senior classification.* Geographic information systems and global positioning systems. Sampling strategies for precision farming. Building prescriptions and recommendations. Systems for precision farming, equipment, software uses, legal and social issues, and economics. Field trip fee, materials fee.

AST 335. Tractor Power. (3-3) Cr. 4. F. *Prereq: Math 140, 142.* Theory and construction of tractor engines, mechanical power trains and hydraulic systems. Introduction to traction, chassis mechanics, and hydraulic power. Materials fee.

AST 337. Fluid Power Systems for Agriculture. (1-3) Cr. 2. Alt. S., offered 2001. *Prereq: AST 335.* Fundamental hydraulic principles. Hydraulic fluid properties. Function and performance of pumps, valves, actuators, lines, and accessories. Operation and maintenance of hydraulic systems.

AST 358. Small Power Equipment. (1-2) Cr. 2. F.S. Principles of operation, adjustment, maintenance and repair of small internal-combustion engines and associated equipment. Materials fee.

AST 360. Electric Power for Agriculture. (2-3) Cr. 3. F. *Prereq: Math 140.* Basic electricity. Electrical safety, wiring, 3-phase service, controls, and motors for agricultural applications. Programmable controller applications. Planning lighting and electrical systems. Field trip fee, materials fee.

AST 362. Systems for Preservation of Grain Quality. (2-3) Cr. 3. S. *Prereq: 3 credits in math.* Principles and management practices for grain preservation with emphasis on corn. Grain quality evaluation. Psychrometrics. Grain drying and dry grain storage. High moisture systems. Grain handling system layout and cost analysis. Field trip fee, materials fee.

AST 397. Internship in Agricultural Systems Technology. Cr. R. F.S.SS. *Prereq: Sophomore classification in AST and approval of adviser.* A supervised work experience in an approved learning setting with application to agricultural systems practices and principles.

AST 398. Cooperative Education in Agricultural Systems Technology. Cr. R. F.S.SS. *Prereq: Junior classification in AST and approval of cooperative coordinator.* All cooperative education students must register for this course prior to commencing each work period.

AST 403. Senior Seminar. (1-0) Cr. 1. F. *Prereq: Senior classification.* Development of professionalism and ethics. Career search; resume and cover letter preparation; interviews. Oral and written communication applications.

AST 420. Land Drainage and Irrigation. (2-0) Cr. 2. Off campus, offered as demand warrants. *Prereq: 324, Agron 154.* Technical, economic, and environmental aspects of the planning and management of farm field drainage and irrigation systems. Application of theory from engineering, soil science, and plant science to the solution of real-world problems. Designed for master of agriculture program. Nonmajor graduate credit.

AST 425. Impacts of Agriculture on Water Quality. (2-0) Cr. 2. F. *Prereq: One of the following: 324, Agron 154.* Relationship between agriculture and water quality; chemical use; erosion and conservation tillage; water quality monitoring techniques; animal waste and water quality; nonpoint source pollution; management systems to reduce chemical leaching to groundwater. Nonmajor graduate credit.

AST 430. Farm Machinery Principles and Mechanisms. (2-3) Cr. 3. Alt. S., offered 2000. *Prereq: 330, 335, Phys 111.* Advanced principles of agricultural machine mechanisms and components. Forces, strength, energy and motion in machinery and its components. Materials fee. Nonmajor graduate credit.

AST 434. Farm Machine Mechanisms. (2-0) Cr. 2. Off campus, offered as demand warrants. *Prereq: 3 credits in math.* Principles of clutches, universal

joints and belt, chain, gear, and hydraulic drives. Analysis of linkages used in agricultural machinery. Constraints and limitations for successful operation. Designed for master of agriculture program. Nonmajor graduate credit.

AST 435. Agricultural Safety. (1-3) Cr. 2. F. *Prereq: 3 credits in math.* Fundamentals of safety, injury collection, analysis and investigation, risk assessment, fault tree analysis, and hazard communications applied to agricultural operations. Exploration of noise, indoor air quality, chemicals, machinery, fire, and confined space hazards identification and injury prevention interventions. Materials fee. Nonmajor graduate credit.

AST 460. Agricultural Electronics. (1-3) Cr. 2. Alt. S., offered 2000. *Prereq: 260 or 360.* Electronics to sense, monitor, and control processes in power and machinery, grain operations, animal environment, and natural resources. Semiconductors, digital logic circuits; speed, pressure, position, temperature, and moisture sensors; electrohydraulics; programmable logic controllers. Materials fee. Nonmajor graduate credit.

AST 462. Post-Harvest Grain Technology. (2-0) Cr. 2. Off campus, offered as demand warrants. *Prereq: 6 credits in agricultural or biological science, 3 credits in math.* Grain drying and high-moisture preservation methods with emphasis on corn. Psychrometrics. Fans and airflow. Grain handling methods and system planning, corn milling, soybean processing. Designed for master of agriculture program. Nonmajor graduate credit.

AST 464. Grain Process Operations. (1-2) Cr. 2. Alt. S., offered 2001. *Prereq: 362 or 462.* Grain quality measurement, end-use value analysis, grain handling, corn milling, oilseed processing, and seed conditioning. Field trip fee, materials fee. Nonmajor graduate credit.

AST 473. Animal Production Systems. (3-0) Cr. 3. F. *Prereq: 3 credits in math. Junior or senior classification only.* Response of animals to the thermal environment. Environmental systems for animal production. Water, feed handling and waste management systems. Planning confinement facilities for swine, beef and dairy production systems. Materials fee. Credit may not be applied toward graduation in both 273 and 473. Nonmajor graduate credit.

AST 474. Livestock Housing Systems. (2-0) Cr. 2. Off campus, offered as demand warrants. *Prereq: 6 credits in agricultural or biological science, 3 credits in math.* Properties of moist air, effects of environment on animal performance, principles of environmental control, feed handling systems, manure management alternatives, and planning total systems. Designed for master of agriculture program. Materials fee. Credit in only one of 273, 473, or 474 for may be used for graduation. Nonmajor graduate credit.

AST 475. Manure Management Systems for Livestock Production. (3-0) Cr. 3. S. *Prereq: 6 credits in agricultural or biological sciences, Math 140.* Livestock manure production, properties, collection, transport, storage, treatment and utilization. Regulations and environmental impacts. Systems for nutrient management and odor abatement. Practical design criteria and procedures for planning livestock manure handling systems. Materials fee, field trip fee. Nonmajor graduate credit.

AST 476. Planning Agricultural Structures and Farmstead Systems. (2-2) Cr. 3. S. *Prereq: 273 or 473.* Layout and organization of farmstead systems. Planning farm homes, farm shops, machine sheds, crop storage structures, and livestock production buildings. Analysis of building plans and calculating building costs. Building materials including timber, concrete and steel; construction methods and structural analysis. Materials fee. Nonmajor graduate credit.

AST 477. Animal Environment. (2-0) 8 weeks. Cr. 1. *Prereq: Classification in veterinary medicine.* Effect of environment on animal production. Animal environmental control and troubleshooting. Manure management. Regulations. Building layout. Case studies which may be witnessed once students are

practicing veterinarians. Materials fee. Nonmajor graduate credit.

AST 490. Independent Study. Cr. 1 to 3. *Prereq:* Junior or senior classification, permission of instructor. A maximum of 6 credits of 290 and 490 may be used toward the total of 128 credits required for graduation. Nonmajor graduate credit.

- A. Animal Environment/Air Quality
- C. Computer Operations
- E. Electrical/Electronics
- G. Grain Operations
- H. Honors
- I. Safety and Human Factors
- K. Bioprocessing
- L. Livestock Production Systems
- M. Machine Systems
- N. Energy
- S. Soil and Water Resources
- T. Structures/Buildings
- W. Waste Management

AST 493. Workshop in Agricultural Systems Technology. Cr. 1. Offered as demand warrants.

Prereq: Permission of instructor. Materials fee. Nonmajor graduate credit.

- A. Environment and Structures
- B. Waste Management
- C. Computer Operations
- D. Electricity and Electronics
- E. Metals Fabrication
- F. Grain Operations
- G. Safety and Human Factors
- H. Water Quality
- I. Erosion Control
- J. Tractor Power and Machine Systems
- K. Swine Production Systems

AST 496. Agricultural Systems Analysis and Planning. (1-4) Cr. 3. S. *Prereq:* 12 credits in AST and senior classification in agriculture. Student teams prepare oral and written reports on term projects involving analysis and planning of systems for agriculture. Team projects include problem solving, solution evaluation, cost analysis, and use of computer decision-aid and computer graphics to prepare plans and reports. Materials fee. Nonmajor graduate credit.

AST 498. Cooperative Education in Agricultural Systems Technology. Cr. R. F.S.SS. *Prereq:* Senior classification in AST and approval of cooperative coordinator. All cooperative education students must register for this course prior to commencing each work period.

Agronomy

Tom E. Loynachan, Interim Head of Department

Distinguished Professors: Fehr, Hallauer

Professors: Anderson, Barnhart, Benson, Blackmer, Burris, Campbell, Carlson, Cianzio, Cruse, Fenton, Hodges, Horton, Imsande, Keeney, Killorn, Lee, Loynachan, Miller, Moore, Mullen, Owen, Pearce, Peterson, Sandor, Schafer, Schnable, Shibles, Swan, Tabatabai, Takle, Taylor, Voss, Whigham, Yarger

Professors (Collaborators): Buhler, Hatfield, Jaynes, Karlen, Lamkey, Palmer, Shoemaker, Wilson

Distinguished Professors (Emeritus): Black, Bremner, Frey, Pesek, Russell, Scholtes, Shaw

Professors (Emeritus): Amemiya, Anderson, Atkins, Carlson, Duncan, George, Green, Hanway, Larson, Schaller, Scott, Shrader, Skrdla, Stritzel, H. Thompson, L. Thompson, Troeh, Wedin, Woolley

Associate Professors: Anderson, Arritt, Dekker, Gutowski, Hartzler, Knapp, Liebman,

Mallarino, Peterson, Salvador, Sawyer, Thompson, Westgate

Associate Professors (Adjunct): Wang

Associate Professors (Collaborators): Bretting, Kaspar, Keeling, Laird, Logsdon, Moorman, Olson, Radke

Assistant Professors: Becraft, Brummer, Burras, Delate, Farnham, Gibson, Gu, Halverson, Henning, Holland, Polito

Assistant Professors (Collaborators): Cambardella, Guan, Martens, Pollak, Prueger, Scott, Widrechner

Instructors: Ziegler

You can get additional departmental information at our website: <http://www.agron.ias.tate.edu>

Undergraduate Study

For undergraduate curriculum in agronomy, see *College of Agriculture, Curricula*.

The Department of Agronomy provides a curriculum for students interested in crop science, soil science, agricultural meteorology and environmental science.

Students selecting agronomy as a major will elect an option in general agronomy, environmental science, or science.

Graduates have the theoretical and practical knowledge needed for efficient and sustainable production of food, feed, and fiber. They have a broad understanding of the role and diversity of plants, soils, and climates of the world. Graduates are skilled in communications, problem-solving, and working effectively with others. They understand the ethical, cultural, and environmental dimensions of issues facing professionals in agriculture and natural resources.

An agronomy major prepares students for employment in agricultural business and industry, agricultural service organizations, crop production and soil management, environmental and natural resource management, farm management, and governmental agencies. Graduates pursue careers in the seed, fertilizer, and agricultural chemical industries as field agronomists, crop and soil management specialists, research technicians, sales and marketing specialists, and production managers. State and federal agencies employ agronomists as extension specialists, county extension directors, environmental and natural resource specialists, research associates, soil surveyors, soil conservationists, and in regulatory agencies as plant, food, and grain inspectors. Additional areas of work open to agronomists include integrated pest management, land appraisal, agricultural finance, turfgrass management, and the home lawn care industry.

The department offers a minor in agronomy. Students are required to complete an approved minor program that includes Agron 114, 154, 212 or 230, 260 or 354, and 6 or more credits in the 300- and 400-level agronomy courses. The total credits taken in residence for a minor must not be less than 15 from a list of approved agronomy courses. Students work with an agronomy advisor to

select courses in crops, soils, and meteorology that are appropriate to their career goals. A list of approved courses is available from an agronomy advisor.

Students can also design a strong basic science education in crop science, soil science, agricultural meteorology, or biotechnology to prepare themselves for science-based jobs, graduate study, or for research careers.

Graduate Study

The department offers the degrees master of science and doctor of philosophy, with majors in agricultural meteorology; crop production and physiology with optional specializations in seed science and weed science; plant breeding; and soil science with specialization in soil chemistry, soil fertility, soil management, soil microbiology and biochemistry, soil morphology and genesis, or soil physics. Minor work is offered for students with majors in other departments. An M.S. nonthesis option is available for students desiring a general degree program with additional coursework and a written creative component substituting for thesis research.

Graduates have a broad knowledge base germane to their area of study. They are trained to integrate and apply knowledge to different situations. Students develop skills in scientific reasoning, organization, and logical presentation of ideas.

The department also offers a master of science degree in agronomy designed for the continuing education of professional agronomist. The program is taught at a distance using computer-based instructional media. It is a nonthesis degree requiring completion of a written creative component.

The department also cooperates in the interdepartmental program in professional agriculture; interdepartmental majors in ecology and evolutionary biology, genetics, MCDB (molecular, cellular, and developmental biology), plant physiology, and water resources.

Prerequisite to major work in this department is completion of an undergraduate degree program with emphasis on agronomic, biological, and physical sciences. The foreign language requirement, if any, for the Ph.D. degree is established on an individual basis by the program of study committee appointed to guide the work of the student.

Courses open for nonmajor graduate credit: 306, 334, 342, 351, 351L, 354, 356, 402, 404, 406, 421, 434, 473, 485, 493.

Courses Primarily for Undergraduate Students

Agron 105. Leadership Experience. Cr. R. F.S.SS. Staff. A participatory experience in activities or completion of a course that enhances the development of leadership and group-dynamic skills. See adviser for departmental requirements.

Agron 110. Professional Development in Agronomy: Orientation. (1-0) Cr. R. F. Pogranichny and Loynachan. Orientation to college life, the profession of agronomy, and the agronomy curriculum.

Agron 114. Fundamentals of Agronomy. (2-3 to 4 individualized study). Cr. 3. F.S. Mullen. A foundation course in crop production and soil management principles for the basic agronomic crops. Includes intro-

ductory concepts of plant, soil, tillage, pest, environmental, and sustainable aspects of crop production. Development of beginning problem-solving skills is integrated into course materials.

Agron 120. Introduction to Renewable Resources. (Same as A Ecl 120, AST 120, Env S 120, For 120.) (3-0) Cr. 3. F.S. Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

Agron 154. Fundamentals of Soil Science. (2-2 to 4 individualized study) Cr. 3. F.S. *Prereq:* Chem 163. Schafer. Introduction to physical, chemical, and biological properties of soils, their formation, classification, and distribution. Use of soil survey and computer databank information in balancing agronomic, economic, and environmental concerns in soil management. Credit for only one of 154, 155, or 156 may be applied toward graduation, not both.

Agron 155. Soils for Horticultural Scientists. (2-2 to 4 individualized study) Cr. 3. F.S. *Prereq:* Chem 163. *Restricted to students in Horticulture.* Schafer. Physical, chemical and biological properties of natural and manufactured soils. Use of soil information when producing plants on natural and manufactured soils. Credit for only one of 154, 155, or 156 may be applied toward graduation.

Agron 156. Soils for Urban Use. (2-2 to 4 individualized study) Cr. 3. F.S. *Restricted to students outside the College of Agriculture.* Schafer. Fundamental properties of soils and their application to urban settings. Development of a site plan for area of land using data from soil survey and computerized data bank information. Field trip. Field trip fee. Credit for only one of 154, 155 or 156 may be applied toward graduation, not both.

Agron 206. Introduction to Meteorology. (Same as Mteor 206.) (3-0) Cr. 3. F.S. R. Carlson or Yarger. Basic concepts in meteorology, including atmospheric measurements, radiation, stability, precipitation, winds, fronts, forecasting, and severe weather. Applied topics include global warming, ozone depletion, El Nino, world climates, weather safety, and atmospheric optics. Self study section available to resident and distant education students all semesters.

Agron 210. Professional Development in Agronomy: Career Planning. (1-0) Cr. 1. F.S. *Prereq:* *Sophomore classification.* Staff. Career planning, résumé preparation, interviewing, and information access and organization relevant to professional opportunities in agronomy. Career orientation through invited speakers.

Agron 212. Grain and Forage Crops. (3-2) Cr. 4. F.S. *Prereq:* 114. Gibson. Production and management practices for corn, soybean, small grain, and forage crops common to Midwest agriculture. Laboratory topics emphasize crop management, growth and development, quality, plant characteristics, and pest management.

Agron 220. Crop Quality, Utilization, and Evaluation. (1-2) Cr. 2. S. *Prereq:* 114. Campbell. Uses and processing of agronomic crops. Factors affecting crop quality, commercial grades, and utilization. One 1-day and one one-half day field trips are required. Field trip fee.

Agron 230. Crop Structure-Function Relationships. (3-0) Cr. 3. F.S. *Prereq:* Biol 202. Salvador. Basic principles concerning the growth, development, and production of crop communities in relation to their environment.

Agron 260. Soils and Environmental Quality. (2-3) Cr. 3. F.S. *Prereq:* 154. Burras. Role of soils in environmental quality and natural resources management. Emphasis on soil erosion and conservation, land reclamation, water quality, pollution management, and environmental planning.

Agron 283. Pesticide Application Certification. (Same as Ent 283.) See *Entomology*.

Agron 298. Cooperative Education. Cr. R each time taken. F.S.SS. *Prereq:* *Permission of department cooperative education coordinator, sophomore classification.*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Agron 306. Use of Weather Data in Agriculture. (Same as Mteor 306.) (1-1) Cr. 1. S. *Prereq:* 206. R. Carlson. Instrumentation, collection, and analyses of weather data relative to crop production in the Midwest. Weather parameters are described by using computer application examples and laboratory exercises. Nonmajor graduate credit.

Agron 310. Professional Development in Agronomy: Internship. Cr. R. F.S.SS. Staff. Professional work experience in agronomy. See adviser for departmental requirements.

Agron 317. Principles of Weed Science. (Same as P M 317, PI HP 317.) (2-2) Cr. 3. F.S. *Prereq:* Biol 207. Gibson, Liebman. Principles and practices of modern weed management systems. Identification, biology, and ecology of weeds; competition of weeds with desirable plants; herbicide use; environmental considerations; and different types of weed control practices.

Agron 320. Genetics, Agriculture and Biotechnology. (Same as Gen 320.) (3-0) Cr. 3. F.S. *Prereq:* Biol 201 and 202. Transmission genetics with an emphasis on applications in agriculture, the structure and expression of the gene, how genes behave in populations and how recombinant DNA technology can be used to improve agriculture. Credit for graduation will not be allowed for more than one of the following: Gen 260, 301, 320 and Biol 301 and 301L.

Agron 330. Crop and Seed Identification Laboratory. (0-4) Cr. 2. S. *Prereq:* 114. Mullen. Identification, agronomic and binomial classification of crops, weeds, and diseases. Analysis of crop seed samples for contaminants of weed and other crop seeds.

Agron 331. Intercollegiate Crop Identification, Seed Analysis and Grain Grading. (0-6) Cr. 2. F. *Prereq:* 330, *permission of instructor; 220 recommended.* Reedy, Mullen. Intensive training in crop, weed, and disease identification, seed analysis, and grain grading for intercollegiate competition in regional and national crops contests. Field trip fee.

Agron 334. Forage Crop Management. (2-0) Cr. 2. S. *Prereq:* 114. Wiedenhoef. Management of forage crop legume and grass species as related to climate, soils, and utilization for harvested hay/silage, pasture, soil conservation, and wildlife. Production and management concepts applied to yield, quality, stand persistence, and use of forage species. Nonmajor graduate credit.

Agron 338. Seed Science and Technology. (Same as Hort 338.) (2-2) Cr. 3. S. *Prereq:* 114 or Hort 221, Biol 201. Knapp. Seed production, maturation, dormancy, vigor, deterioration, and related aspects of enhancement, conditioning, storage, and quality evaluation. Aspects of the seed industry and regulation of seed marketing.

Agron 342. World Food Issues: Past and Present. (Same as FS HN 342, T SC 342, U St 342.) (3-0) Cr. 3. S. Salvador. World food problems in context of historical development of agriculture in major cradles of civilization. Emphasis on population trends and socioeconomic policies to understand disparities between potential agricultural production and present energy and nutritional deficiencies in key areas of the developing world. Team projects. Materials fee. Nonmajor graduate credit.

Agron 351. Turfgrass Establishment and Management. (Same as Hort 351.) See *Horticulture*. Nonmajor graduate credit.

Agron 351L. Turfgrass Establishment and Management Laboratory. (Same as Hort 351L.) See *Horticulture*. Nonmajor graduate credit.

Agron 354. Soils and Plant Growth. (Same as PI HP 354.) (3-0) Cr. 3. F.S. *Prereq:* 154 and Biol 109 or 202. Killorn or Loynachan. Effects of chemical, physical, and biological properties of soils on plant growth, with emphasis on nutritive elements, pH, organic matter maintenance, and rooting development. Nonmajor graduate credit.

Agron 354L. Soils and Plant Growth Laboratory. (Same as PI HP 354L.) (0-3) Cr. 1. F. S. *Prereq:* *Credit or enrollment in 354.* Henning. Laboratory exercises in soil testing that assess a soil's ability to support nutritive requirements for plant growth.

Agron 356. Soil, Fertilizer, and Water Management. (3-2) Cr. 4. F. *Prereq:* 354; 114 *recommended.* Polito, Schafer. Integration of crop, tillage, drainage, irrigation, erosion, fertility, and fertilizer information in management decisions. Economic and environmental implications of these decisions on long-term sustainability. Suitability and accuracy of soil evaluation methods. Handling characteristics and soil reactions of organic and mineral fertilizers. An in-depth farm plan will be developed for a client. Materials fee. Nonmajor graduate credit.

Agron 360. Environmental Soil Science. (Same as EnSci 360) (2-3) Cr. 3. S. *Prereq:* Agron 260 or Geol 100 or 201. Application of soil science to contemporary environmental problems; comparison of the impacts that different management strategies have on short- and long-term environmental quality and land development. Emphasis on participatory learning activities.

Agron 370. Field Experience in Soil Description and Interpretation. (0-3) Cr. 1. Can be taken four times. F.S. *Prereq:* 154 and *permission of instructor.* Sandor. Description, and interpretation of soils in the field and laboratory, emphasizing hands-on experience. Evaluation of soil information for land use. Students may participate in intercollegiate judging contests.

Agron 392. Systems Analysis in Crop and Soil Management. (2-3) Cr. 3. F.S. *Prereq:* 230, 354. Salvador, Wiedenhoef. Management strategies at the level of the farm field. Emphasis will be on participatory learning activities.

Agron 398. Cooperative Education. Cr. R each time taken. F.S.SS. *Prereq:* *Permission of department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Agron 402. Watershed Hydrology and Surficial Processes. (Same as EnSci 402, For 402, Geol 402.) (3-3) Cr. 4. F. *Prereq:* EnSci 330 or Geol 100 or 201, Phys 111, 3 credits in biology and 6 credits in chemistry. Burras, Schultz, and Simpkins. Examination of watersheds as systems wherein biological and physical factors control hydrology, soil formation, and nutrient transport. Laboratory emphasizes field investigation of watershed-scale processes. Nonmajor graduate credit.

Agron 402I. Watershed Hydrology and Evolution. (Same as EnSci 402I, Ia LL 402I.) See *Iowa Lakeside Laboratory*.

Agron 404. Global Change. (Same as EnSci 404, Env S 404, Mteor 404.) (3-0) Cr. 3. S. Takle. Biogeochemical cycles, ozone chemistry, global energy balance, structure and circulation of the atmosphere and oceans, climate modeling, climate variability, implications for agriculture, water resources, energy use, sustainable development and public policy. Human dimensions and ethical issues of global environmental change. Nonmajor graduate credit.

Agron 406. Climate of the Continents. (Same as Mteor 406.) (2-0) Cr. 2. F. *Prereq:* Agron/Mteor 206. R. Carlson. The major climate controls and how they affect the world climate. Climate classification. Combining controls and classification to explain the pattern of climates of the different continents and the world. Nonmajor graduate credit.

Agron 407. Mesoscale Meteorology. (Dual-listed with 507; same as Mteor 407.) (3-0) Cr. 3. S. *Prereq:* Math 166 and Mteor 454. Arritt, Gallus. The physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure.

Agron 410. Professional Development in Agronomy: Senior Forum. (1-0) Cr. 1. F.S. *Prereq:* *Senior classification.* Staff. Development of an appro-

prate content for professionalism. Topics include professional certification, ethics, and maintaining an active network of information sources and professional contacts in support of lifelong learning. Student interpretation, writings, presentations, and discussions.

Agron 421. Introduction to Plant Breeding. (3-0) Cr. 3. F.S. *Prereq:* Biol 201; 320 recommended. Campbell. Breeding methods used in the genetic improvement of self-pollinated, cross-pollinated and asexually reproducing agronomic crops. Applications of molecular techniques and biotechnological advancements as breeding tools in the development of improved cultivars and transgenic plants. Nonmajor graduate credit.

Agron 434. Forage Quality and Utilization. (2-0) Cr. 2. Alt. F. *Prereq:* 334. Barnhart. Systems of forage utilization including grazing, hay, and silage. Nutritional chemistry of forage plants and the genetic, environmental, and post-harvest factors that influence their use. Students enrolling for graduate credit will be expected to complete an additional class project. Nonmajor graduate credit.

Agron 446. World Agronomic Systems. (3-0) Cr. 3. S. *Prereq:* 114, 154, 206. Mullen and staff. Interdisciplinary study and comparison of agricultural systems around the world, including analysis of biophysical, social, economic, and political determinants of the systems. Emphasis on the interrelationships among system determinants. Analysis of system constraints and solution strategies. Evaluation of the productivity and sustainability of the systems. Team project and report.

Agron 450. Issues in Sustainable Agriculture. (Same as Env S 450.) (2-0) Cr. 2. F. Salvador. Agricultural science as a human activity; contemporary agricultural issues from agroecological perspective. Comparative analysis of intended and actual consequences of development of industrial agricultural practices. Field trip fee.

Agron 459. Environmental Soil Chemistry. (Dual-listed with 559; same as EnSci 459.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* Agron 354 or EnSci 401, Chem 210 or 211. Evangelou. An introduction to the chemical properties of soils, chemical reactions and transformations occurring in the soils and their impact on the environment. Topics include composition of soils, acid-base equilibria, buffer systems, mineral dissolution and precipitation, speciation, ion exchange, redox reactions, adsorption phenomena, soil pollution and chemical-equilibria computer programs.

Agron 460. Agroforestry Systems. (Dual-listed with 560; same as For 460.) See *Forestry*.

Agron 473. Soil Genesis and Landscape Relationships. (Same as EnSci 473.) (2-3) Cr. 4. S. *Prereq:* 154 or 402 or EnSci 402. Sandor. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Field trip fee. Nonmajor graduate credit. Credit for only 473 or 4731 may be applied for graduation, not both.

Agron 4731. Soil Genesis and Landscape Relationships. Cr. 4. Alt. SS. offered 2000 at Lakeside Laboratory. *Prereq:* Agron 154 or 402. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for only 473 or 4731 may be applied for graduation, not both.

Agron 485. Soil Microbial Ecology. (Same as EnSci 485, Micro 485.) (2-3) Cr. 3. F. *Prereq:* 154, Micro 201 (Micro 203 recommended). Loynachan. The living organisms in the soil and what they do. Emphasis on soil-plant-microbial relationships and environmental issues. Nonmajor graduate credit.

Agron 490. Independent Study. Cr. 1 to 3 each time taken; 4 cr. maximum allowed toward the total of 128 credits required for graduation. F.S.SS. *Prereq:* Junior or senior classification with at least 8 credits in agronomy; permission of instructor in specialty area after consultation. Selected studies in crops, soils, or agricultural meteorology according to

the needs and interests of the student.

H. Honors

Agron 491. Seed Science Experience. Cr. 2 to 4. F.S.SS. *Prereq:* 338, advance approval and participation of employer and instructor. Staff. A professional work experience and creative project for seed science majors. The project requires the prior approval and participation of the employer and instructor and a written report.

Agron 492. Agronomic Issues: Science, Policy, and Resource Management. (2-0) Cr. 2. F.S. *Prereq:* Senior classification. Knapp. Objective investigation of current agricultural issues from multiple perspectives. Students will develop positions on or solutions to current agricultural issues by investigating the scientific, technical, economic, environmental, and social ramifications of agriculture and agricultural policy.

Agron 493. Workshop in Agronomy. Cr. arr each time taken, maximum of 4. *Prereq:* Permission of instructor. Staff. Workshop experience in crops, soils, or agricultural meteorology. Nonmajor graduate credit.

Agron 495. Agricultural Travel Course Preparation. (0-1) Cr. R. May be repeated. F.S. *Prereq:* Permission of instructor. Limited enrollment. Students enrolled in this course also register for An S 495 and intend to register for Agron 496 and An S 496 the following term. Topics will include the agricultural industries, climate, crops, culture, economics, geography, history, livestock, marketing, soils, and preparation for travel to locations to be visited. Information normally available 9 months before departure.

Agron 496. Agricultural Travel Course. Cr. arr. (approx. one-half credit per week traveled each An S 496 and Agron 496). May be repeated. *Prereq:* Permission of instructor. Limited enrollment. Students enroll in both An S 496 and Agron 496. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on crop and livestock production. Location and duration of tours will vary. Summer tour will usually visit a northern location and winter tour will usually visit a southern location. Information usually available 9 months before departure. Tour expenses paid by students. Field trip fee.
A. International Tour
B. Domestic Tour

Agron 498. Cooperative Education. Cr. R each time taken. F.S.SS. *Prereq:* Permission of department cooperative education coordinator; senior classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, open to qualified undergraduate students

Agron 500. Orientation Seminar. (2-0). Cr. 1. F. *Prereq:* International agronomy graduate students only. Pesek and staff. An introduction to Iowa and U.S. agriculture for international scholars in agronomic majors. Field trips when possible. Departmental role in the functioning of research, teaching, and extension in fulfilling the charge given the land-grant university. Offered on a satisfactory-fail grading basis only.

Agron 501. Crop Growth and Development. (2-0) Cr. 2. F. *Prereq:* Enrollment in distance M.S. in Agronomy. Staff. Physiological processes in crop growth, development and yield: photosynthesis, respiration, water relations, mineral nutrition, partition of assimilates, seedling vigor, light interception and canopy growth, root growth, reproduction and yield. Restricted to students admitted to the distance education M.S. in Agronomy degree program.

Agron 502. Chemistry, Physics, and Biology of Soils. (2-0) Cr. 2. F. *Prereq:* Enrollment in distance M.S. in Agronomy. Staff. Soil chemical, biological, and physical properties which control processes within the soil and influence plant/soil interactions will be studied. A series of computer based deliveries will prepare the student to understand problems

associated with soil and crop science applications. Restricted to students admitted to the distance education M.S. in Agronomy degree program.

Agron 503. Climate and Crop Growth. (2-0) Cr. 2. F. *Prereq:* Enrollment in distance M.S. in Agronomy. Taylor. Applied concepts in agricultural meteorology with emphasis on the weather-agriculture relationship and the microclimate-agriculture interaction. Restricted to students admitted to the distance education M.S. in Agronomy degree program.

Agron 504. Global Change. (Dual-listed with 404; same as Mteor 504.) See *Geological and Atmospheric Sciences, Meteorology*.

Agron 505. Biometeorology. (Same as Mteor 505.) (3-0) Cr. 3. F. *Prereq:* Agron/Mteor 206. Arritt. The heat exchange near the ground. Radiation, turbulence, conductance and evaporation as components of the heat balance. Temperature, wind and humidity conditions in the microclimate. Modification of the microclimate. Computer modeling of biophysical processes. Semester project required.

Agron 507. Mesoscale Meteorology. (Dual-listed with 407; same as Mteor 507.) (3-0) Cr. 3. S. *Prereq:* Math 166 and Mteor 454. Arritt, Gallus. The physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure.

Agron 508. Biophysical Crop Ecology. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 505. Taylor. Principles of resource capture (light and water) applied to growth and development. Ecological implications of radiation, temperature, moisture, and the biological properties of size, shape, resistance to water vapor loss, and absorptivity to solar and thermal radiation. Physiological stress in the soil, plant, atmosphere continuum.

Agron 511. Crop Improvement. (2-0) Cr. 2. S. *Prereq:* Credit or enrollment in 513. Campbell. Basic principles in the genetic improvement of crop plants and seed production. Methods of cultivar development, relationship of reproductive characters and growth characteristics to genetic characteristics of crops. Factors affecting the production of high quality seed. Restricted to students admitted to the distance M.S. in Agronomy degree program.

Agron 512. Soil-Plant Environment. (2-0) Cr. 2. S. *Prereq:* 502. Staff. Plant/soil interactions and soil processes will be highlighted in this course. Nutrient and water uptake and the role soil properties play in these processes will be presented. Students will study the processes and effects of soil compaction and erosion. Computer models will be used to study the impact of soil properties on soil temperature. Restricted to students admitted to the distance education M.S. in Agronomy degree program.

Agron 513. Quantitative Methods for Agronomy. (2-0) Cr. 2. S. *Prereq:* Enrollment in distance M.S. in Agronomy. Moore. Quantitative methods for analyzing and interpreting agronomic information. Principles of experimental design, hypothesis testing, analysis of variance, regression, correlation, and graphical representation of data. Use of spreadsheets for manipulating, analyzing, and presenting data. Restricted to students admitted to the distance education M.S. in Agronomy degree program.

Agron 514. Integrated Pest Management. (2-0) Cr. 2. SS. *Prereq:* Enrollment in distance M.S. in Agronomy. Staff. Principles and practices of weed science, entomology, and plant pathology applied to crop production systems. Biology, ecology, and strategies for controlling crop pests. Restricted to students admitted to the distance education M.S. in Agronomy degree program.

Agron 516. Crop Physiology and Management. (3-0) Cr. 3. S. *Prereq:* Bot 320. Westgate. Physiological and biochemical processes and their relationships to crop growth, development, and yield.

Agron 517. Weed Biology and Ecology. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 317, Bot 484. Dekker. Weed evolution and biodiversity for exploitation of disturbed and managed habitats. Selection and adaptation of weeds in agronecosystems: soil weed seed

banks, population shifts, and crop-weed interactions. The genetic basis of colonizing plant species.

Agron 519. Herbicide Physiology and Biochemistry. (2-0) Cr. 2. Alt. S., offered 2001. *Prereq:* 317; Bot 320. Owen. Herbicide mechanisms of action, selectivity, uptake, and translocation. Specific sites of herbicide action as they affect plant physiology. Herbicide resistance in weeds and crops. Implications of herbicides on weed management.

Agron 521. Principles of Cultivar Development. (3-0) Cr. 3. F. *Prereq:* 421; Stat 401. Fehr. Analysis of alternative breeding methods for improvement of crop plants. Strategies for maximizing genetic gain through recurrent selection and other breeding methods. Relationship of breeding methods to commercial seed production.

Agron 522. Field Methods in Plant Breeding. (0-6) Cr. 2. SS. *Prereq:* 521. Staff. Field experience in planning and conducting plant breeding research for cross-pollinated and self-pollinated crops. Offered on a satisfactory-fail basis only. Field trip fee.

Agron 523. Plant Genetic Resource Management. (2-2) Cr. 3. Alt. F., offered 1999. *Prereq:* 320, permission of instructor. Staff. Principles and practices of *in situ* and *ex situ* plant genetic resource management. Contemporary approaches for plant genetic resource acquisition, maintenance, distribution, characterization, evaluation, enhancement, and utilization are explored in lectures, discussions, and laboratory exercises.

Agron 526. Field Plot Technique. (3-0) Cr. 3. F. *Prereq:* Stat 401. Moore. Planning experiments for agricultural research, analysis of data, and concepts in data interpretation.

Agron 527. Plant Genetics. (3-0) Cr. 3. S. *Prereq:* Gen 410. Brummer. Fundamental genetic and cytogenetic concepts from a plant perspective including recombination, linkage analysis, genetic mapping, chromosomal aberrations, polyploidy, incompatibility systems, and marker-assisted selection.

Agron 531. Crop Ecology and Management. (2-0) Cr. 2. F. *Prereq:* 501. Farnham. Environmental factors affecting crop growth and yield. Climatic and edaphic adaptation of crop species. Management systems for crops with an emphasis on row and forage crops common to the Midwest. Restricted to students admitted to the distance education M.S. in Agronomy degree program.

Agron 532. Soil Management. (2-0) Cr. 2. F. *Prereq:* 502. Cruse. This course is designed to improve problem solving at the field scale. Application of basic information gained in 502 and 512 will be used to develop management practices appropriate for a range of field conditions. Agronomic, economic, and environmental effects of management strategies will be stressed. Restricted to students admitted to the distance education M.S. in Agronomy degree program.

Agron 533. Crop Protection. (2-0) Cr. 2. F. *Prereq:* 514. Staff. Integrated management systems for important crop pests. Cultural, chemical and biological control strategies applicable to major crops grown in the Midwest. Restricted to students admitted to the distance education M.S. in Agronomy degree program.

Agron 534. Forage Quality and Utilization. (2-0) Cr. 2. Alt. F., offered 1999. *Prereq:* 334, 434. Barnhart. Nutritional chemistry of forage plants and the genetic, environmental, and post-harvest factors that influence it. Systems of forage utilization including grazing, hay, and silage.

Agron 538. Seed Physiology. (2-0) Cr. 2. Alt. F., offered 2000. *Prereq:* 338; BBMB 301 or Chem 331. Physiological aspects of seed development, maturation, longevity, dormancy, and germination. Emphasis on current literature and advanced methodology.

Agron 541. Applied Agricultural Meteorology. (2-0) Cr. 2. F.S.SS. Available on and off campus. *Prereq:* 206. Taylor. Applied concepts in agricultural meteorology with emphasis on the weather-agriculture relationship and the microclimate-agriculture interaction. Approved for the master of agriculture

program. Self study section available to resident and distant education students all semesters.

Agron 542. Advanced Crop Management. (2-0) Cr. 2. Off campus, offered as demand warrants. *Prereq:* 230. Staff. Basic concepts in plant-soil-climate relationships with emphasis on recent advances in crop culture and management. Designed for the master of agriculture program.

Agron 544. Soil Management. (2-0) Cr. 2. Off campus, offered as demand warrants. *Prereq:* 354. Blackmer, Cruse. Basic concepts of soil management with emphasis on how various tillage and fertilization practices influence plant growth. Designed for the master of agriculture program.

Agron 550. Advanced Issues in Sustainable Agriculture. (2-2) Cr. 3. F. Salvador. *Prereq:* Two of 114, 154, 212, 516, and permission of instructor. Agricultural science as a human activity; contemporary agricultural issues for agroecological perspective. Comparative analysis of intended and actual consequences of development of industrial agricultural practices. Individual study and group analysis of environmental literature and scientific reports. Field trip fee.

Agron 551. Growth and Development of Perennial Grasses. (Same as Hort 551.) See *Horticulture*.

Agron 553. Soil-Plant Relationships. (3-0) Cr. 3. F. *Prereq:* 354. Blackmer. Composition and properties of soils in relation to the nutrition and growth of plants.

Agron 554. Advanced Soil Management. (2-0) Cr. 2. Alt. S., offered 2000. *Prereq:* 354; Math 165. Cruse. Implications of soil management on the soil environment and root activity. Effect of soil physical properties on soil erosion.

Agron 555. Soil Clay Mineralogy. (Same as Geol 555.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 473, Chem 164; Geol 311 recommended. Thompson. Structure and behavior of clay minerals in soil environments, with emphasis on layer silicates and on Fe, Mn, and Al oxides.

Agron 555L. Soil Clay Mineralogy Laboratory. (Same as Geol 555L.) (0-3) Cr. 1. Alt. F., offered 1999. *Prereq:* Credit or enrollment in 555. Thompson. Application of X-ray diffraction, thermal analysis, infrared spectroscopy, and chemical analyses to identification and behavior of clay minerals in soils.

Agron 558. Laboratory Methods in Soil Chemistry. (2-3) Cr. 3. Alt. F., offered 1999. *Prereq:* 354 and Chem 210 or 211. Tabatabai. Experimental and descriptive inorganic and organic analyses. Operational theory and principles of applicable instruments, including spectrophotometry, atomic and molecular absorption and emission spectroscopy, mass spectrometry, X-ray diffraction and fluorescence, gas and ion chromatography, and ion-selective electrodes.

Agron 559. Environmental Soil Chemistry. (Dual-listed with 459.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 354, Chem 210. Evangelou. An introduction to the chemical properties of soils, chemical reactions and transformations occurring in the soils and their impact on the environment. Topics include composition of soils, acid-base equilibria, buffer systems, mineral dissolution and precipitation, speciation, ion exchange, redox reactions, adsorption phenomena, soil pollution and chemical-equilibria computer programs.

Agron 560. Agroforestry Systems. (Dual-listed with 460; same as For 560.) See *Forestry*.

Agron 561. Population and Quantitative Genetics for Breeding. (4-0) Cr. 4. F. *Prereq:* Stat 401 or concurrent registration. Fernando and Holland. Introduction to population and quantitative genetics for plant and animal breeding. Forces that can change gene frequency, covariance between relatives, response to selection, artificial selection, estimation of variance components, inbreeding depression, heterosis, cross-breeding, genotype x environment interaction, selection experiments, introduction to quantitative genetics loci mapping.

Agron 575. Soil Morphology, Genesis, and Classification. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 459, 473; Geol 100. M. Thompson. Synthesis of how landscapes, water, organisms, and chemical reactions determine the morphology, mineralogy and spatial distribution of soils.

Agron 577. Soil Physics. (3-0) Cr. 3. S. *Prereq:* 354; Math 166 recommended. Horton. The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

Agron 578. Laboratory Methods in Soil Physics. (0-3) Cr. 1. S. *Prereq:* 577 concurrent. Horton. Methods of measuring soil physical properties such as texture, density, and water content, and transport of heat, water, and gases.

Agron 585. Soil Microbiology and Biochemistry. (Same as Micro 585.) (2-0 or 2-3) Cr. 2 or 3. S. *Prereq:* 485, one course in biochemistry. Loynachan. Ecological and environmental considerations of soil microorganisms, organic matter, enzymes, carbon, and other nutrient cycles. Laboratory emphasizes creative component.

Agron 590. Special Topics. Cr. arr. *Prereq:* 15 credits in agronomy. Literature reviews and conferences on selected topics in crops, soils, or agricultural meteorology according to needs and interest of student.

Agron 591. Agronomic Systems Analysis. (3-0) Cr. 3. S. *Prereq:* 503, 511, 512, 531, 532, 533. Staff. Analysis of cropping systems from a problem-solving perspective. Case studies will be used to develop the students' ability to solve agronomic problems. Restricted to students admitted to the distance education M.S. in Agronomy degree program.

Agron 592. Current Issues in Agronomy. (3-0) Cr. 3. S. *Prereq:* Credit or enrollment in 591. Knapp. Study and discussion of topics of current interest to the field of agronomy. Restricted to students admitted to the distance education M.S. in Agronomy degree program.

Agron 593. Workshop in Agronomy. Cr. arr each time taken. *Prereq:* Graduate classification.
A. Crops
B. Soils
C. Agricultural Meteorology
D. Microcomputers in Agronomy
E. Seed Science
F. Weed Science
G. Agronomy Field Laboratory

Agron 599. Creative Component. Cr. arr. *Prereq:* Nonthesis M.S. option only. A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

A. Agricultural Meteorology
B. Crop Production and Physiology
C. Plant Breeding
D. Soil Chemistry
E. Soil Fertility
F. Soil Management
G. Soil Microbiology and Biochemistry
H. Soil Morphology and Genesis
I. Soil Physics
K. Seed Science
L. Weed Science
M. Agronomy

Courses for Graduate Students

Agron 600. Seminar. (1-0) Cr. 1 each time taken. Reports and discussion of recent literature and research.

A. Plant Breeding. M. Lee (F); K. Lamkey (S).
B. Soils. F.S. Staff.
C. Crop Production and Physiology. F.S. Staff.
600C offered on a satisfactory-fail grading basis only.

Agron 609. Agricultural Meteorology Conference. (1-0) Cr. 1 each time taken. F.S.SS. *Prereq:* Permission of instructor. Staff. Literature reviews and conferences with instructor on special problems relating to agricultural meteorology, beyond the scope of current courses offered.

Agron 616. Advanced Topics in Crop Physiology and Biochemistry. (4-0) Cr. 4. Alt. S., offered 2000. *Prereq:* 516; Bot 511, 513; BBMB 404; permission of instructor. Westgate. An in-depth treatment of physiological and biochemical processes and their relationships to crop growth and development. Emphasis on individual study followed by in-class presentations and discussion.

Agron 621. Advanced Plant Breeding. (3-0) Cr. 3. S. *Prereq:* 521, 526, 561, Stat 402 or An S 550, Gen 410. Hallauer. Estimation and interpretation of genetic effects and variances of plant populations, analysis of mating designs, heritability estimation, intra- and interpopulation selection methods, prediction of genetic gain, inbreeding and heterosis, classification and development of parental materials, selection indices, and combining ability analysis.

Agron 625. Genetic Strategies in Plant Breeding. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 521, Gen 410, Bot 545. Lee. Evaluation of genetic, molecular, and cellular approaches to crop improvement; gene transfer methods. Application and role of basic plant biology in breeding programs and processes; genome structure and function, gene isolation, expression, regulation, and modification. Integration of molecular and cellular methods in breeding strategies; analysis of alternative breeding methods, regulatory and ethical issues.

Agron 629. Colloquium in Plant Breeding and Cytogenetics. (1-0) Cr. 1 each time taken. Alt. S., offered 2000. *Prereq:* Gen 410 and permission of instructor. Peterson. Presentation of papers and informal discussion of related literature in plant breeding and cytogenetics.

Agron 634. Forage Research Methodology. (2-0) Cr. 2. Alt. F., offered 2000. *Prereq:* 434, Stat 402. Moore. Research methodology used to evaluate forage production and quality. Advanced concepts in the design and analysis of forage experiments.

Agron 650. Agronomic Systems Simulation. (2-1) Cr. 3. Alt. S., offered 2001. *Prereq:* Com S 107, 205; Math 166. Salvador, Arritt, Horton. Development and use of mathematical, mechanistic, single process, and systems models for simulation of agronomic processes. Emphasis on mass and energy transfer in soil-crop-atmosphere continuum. Survey of current agronomic simulations, expert systems and decision support systems.

Agron 655. Advanced Soil Fertility. (2-0) Cr. 2. Alt. S., offered 2001. *Prereq:* 553. Blackmer. Evaluation of soil fertility and fertilizers; theory and applications.

Agron 658. Environmental Surface Chemistry. (3-0) Cr. 3. Alt. S., offered 1999. *Prereq:* 559 or 555, Chem 321, and 322. Evangelou. Principles of surface and colloidal chemistry applied to minerals and organic matter in soils, sediments and aquifers. Emphasis on understanding, control and mathematical description of interactions at the solid/liquid interface relevant to movement of agrochemicals, heavy metals and organic pollutant chemicals in the environment.

Agron 675. Advanced Soil Genesis and Classification. (2-0) Cr. 2. Alt. S., offered 2001. *Prereq:* 575. Fenton. Processes, reactions, and theories in soil formation; landscape evolution; principles of soil classification.

Agron 677. Advanced Soil Physics. (2-0) Cr. 2. Alt. F., offered 2000. *Prereq:* 577; Math 266, 267; Com S 205 recommended. Horton. The flow and distribution of water, chemicals, and heat in soils. Physical principles and applications.

Agron 685. Advanced Soil Biochemistry. (Same as Micro 685.) (2-0) Cr. 2. Alt. S., offered 2000. *Prereq:* 585. Tabatabai. Chemistry of soil organic matter and biochemical transformations brought about by microorganisms and enzymes in soils.

Agron 696. Seminar in Plant Physiology and Molecular Biology. (Same as Bot 696.) See *Botany*.

Agron 698. Agronomy Teaching Practicum. Cr. 1 to 2 each time taken. F.S.SS. *Prereq:* Graduate classification in agronomy and permission of instructor. Staff. Graduate student experience in the agronomy

teaching program. Offered on a satisfactory-fail grading basis only.

Agron 699. Research.

- A. Agricultural Meteorology
- B. Crop Production and Physiology
- C. Plant Breeding
- D. Soil Chemistry
- E. Soil Fertility
- F. Soil Management
- G. Soil Microbiology and Biochemistry
- H. Soil Morphology and Genesis
- I. Soil Physics
- J. Plant Physiology
- K. Seed Science
- L. Weed Science

Air Force Aerospace Studies

David Pierce, Interim Chair of Department

Assistant Professor (Adjunct): Pierce

Instructors (Adjunct): Bergman, Standley

Undergraduate Study

The objective of the Department of Air Force Aerospace Studies is to provide qualified students the opportunity to earn a commission as an officer in the active duty Air Force.

The curriculum is divided into two basic phases, the general military course (GMC) and the professional officer course (POC). The GMC is introductory and consists of four consecutive 1-hour courses normally taken during the freshman and sophomore years. The GMC is not prerequisite to entry into the POC, although it is recommended by the department.

Prior to entry into the POC, all students complete field training at an Air Force base. Students who have completed the GMC participate in a 4-week program, which provides a concentrated experience in the Air Force environment. The training program includes junior officer training, aircraft and aircrew orientation, career orientation, survival training, an introduction to typical base functions, and physical training. A 6-week training program is provided for those students entering the POC who did not take the GMC. This program includes all that is offered in the 4-week program, plus the academic and leadership laboratory experiences included in the on-campus GMC courses.

Selection for the professional officer course is on a competitive basis, and cadets enrolling in this course must meet certain academic, mental, physical, and moral standards. Qualified cadets may be selected as flight candidates and receive flight instruction prior to attending Undergraduate Flight Training (UFT). Upon enrollment in the POC, all cadets are required to complete a contractual agreement with the Air Force, which obligates them to 4 years of active duty as an officer in the United States Air Force if in a nonflying category, and 10 years if a pilot or 6 years if a navigator. Uniforms and AFROTC texts are supplied to the cadets, and those in the POC receive a subsistence allowance of \$150 per month.

Entry into the program is not dependent on departmental major or year in the university. A 2-year applicant must, however, spend 2 years as either an undergraduate or graduate student in an approved program in order to satisfy POC enrollment requirements. A student who fails to observe the contract terms may be called to active duty in an enlisted grade or be required to repay monies received from the Air Force.

The best qualified cadets participate in a college scholarship application program (SAP) which may provide payment of full tuition, fees, and textbooks. In addition, the SAP cadet receives the \$150 monthly subsistence allowance paid all cadets who have entered into the contractual agreement. Upon acceptance of a scholarship, the SAP student executes a contract with the Air Force. Scholarships can be awarded for periods of 2 or 3 years, with up to 1 additional year for highly qualified applicants in selected majors. To determine their eligibility and initiate application procedures for the scholarship program, interested students should contact the department.

All scholarship cadets must receive credit for or test out of a course in English composition. Additionally, cadets are encouraged to take a speech communication course.

The AFROTC program is open to both male and female students. Additional information concerning Air Force Officer Education may be obtained from the Professor of Aerospace Studies, Iowa State University. See also *Officer Education*.

Courses Primarily for Undergraduate Students

AFAS 101. Leadership Laboratory I. (0-1) Cr. .5. Air Force customs and courtesies; drill and ceremonies, issuing military commands, instructing, directing and evaluating the preceding skills, studying the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. This laboratory is required if taking AFAS 141, 142 and considering application in the POC. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies.

AFAS 102. Leadership Laboratory I. (0-1) Cr. .5. Air Force customs and courtesies; drill and ceremonies, issuing military commands, instructing, directing and evaluating the preceding skills, studying the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. This laboratory is required if taking AFAS 141, 142 and considering application in the POC. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies.

AFAS 141. The United States Air Force Today. (1-0) Cr. 1. Yr. Development of the Air Force, its mission and organization; emphasis on functions of U.S. strategic offensive, defensive, and special purpose forces; relationships and interaction with Army and Navy forces. Introduction of oral, written, and interpersonal communication skills. Initial military training related to officership and professionalism, engaging in military customs and courtesies, and participating in military ceremonies.

AFAS 142. The United States Air Force Today. (1-0) Cr. 1. Yr. Development of the Air Force, its mission and organization; emphasis on functions of U.S. strategic offensive, defensive, and special purpose forces; relationships and interaction with Army and Navy forces. Introduction of oral, written, and inter-

personal communication skills. Initial military training related to officership and professionalism, engaging in military customs and courtesies, and participating in military ceremonies.

AFAS 201. Leadership Laboratory II. (0-1) Cr. .5. Air Force customs and courtesies, drill and ceremonies, issuing military commands, instructing, directing, and evaluating the preceding skills, the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. Continued military training related to wearing the uniform, engaging in military customs and courtesies, and participating in military ceremonies. This laboratory is required if taking AFAS 241, 242 and applying for the POC. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies.

AFAS 202. Leadership Laboratory II. (0-1) Cr. .5. Air Force customs and courtesies, drill and ceremonies, issuing military commands, instructing, directing, and evaluating the preceding skills, the environment of an Air Force officer and learning about areas of opportunity available to commissioned officers. Continued military training related to wearing the uniform, engaging in military customs and courtesies, and participating in military ceremonies. This laboratory is required if taking AFAS 241, 242 and applying for the POC. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies.

AFAS 241. The Development of Air Power. (1-0) Cr. 1. Yr. Study of military air power through historical events, leaders, technology and politics. Introduction into the basics of leadership, quality, teamwork, and ethics/values. Demonstration of oral, written and interpersonal communication skills.

AFAS 242. The Development of Air Power. (1-0) Cr. 1. Yr. Study of military air power through historical events, leaders, technology and politics. Introduction into the basics of leadership, quality, teamwork, and ethics/values. Demonstration of oral, written and interpersonal communication skills.

AFAS 301. Leadership Laboratory III. (0-2) Cr. .5. Advanced leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. This lab is required if taking AFAS 341, 342, and pursuing a commission. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies.

AFAS 302. Leadership Laboratory III. (0-2) Cr. .5. Advanced leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. This lab is required if taking AFAS 341, 342, and pursuing a commission. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies.

AFAS 341. Air Force Management and Leadership. (3-0) Cr. 3. Yr. Communication skills, management, and leadership: listening, speaking, and writing skills required by an Air Force officer; management tools, practices, and controls; management principles and functions; leadership theory and practices. Introduction to Quality Air Force. Advanced leadership training pertaining to planning, organizing, supervising, and conducting military activities through experiential exercises.

AFAS 342. Air Force Management and Leadership. (3-0) Cr. 3. Yr. Communication skills, management, and leadership: listening, speaking, and writing skills required by an Air Force officer; management tools, practices, and controls; management principles and functions; leadership theory and practices. Introduction to Quality Air Force. Advanced leadership training pertaining to planning, organizing, supervising, and conducting military activities through experiential exercises.

AFAS 401. Leadership Laboratory IV. (0-2) Cr. .5. Advanced leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. This lab is required if taking AFAS 441, 442, and pursuing a commission. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies.

AFAS 402. Leadership Laboratory IV. (0-2) Cr. .5. Advanced leadership experiences involving the planning and controlling of the military activities of the AFROTC cadet corps, the preparation and presentation of briefings and other oral and written communications, and the providing of interviews, guidance, and information that will increase the understanding, motivation, and performance of other cadets. This lab is required if taking AFAS 441, 442, and pursuing a commission. Leadership Laboratory is open to students who are members of the Reserve Officer Training Corps or are eligible to pursue a commission as determined by the professor of aerospace studies.

AFAS 441. National Security Forces in Contemporary American Society. (3-0) Cr. 3. Yr. *Prereq: 342.* The military profession, civil-military interaction, framework of defense policy, formulation of defense strategy and management of conflict. Formulation and implementation of U.S. security policy. Regional studies, military law, and in-depth Air Force doctrine and organization. Analysis of civil-military interactions. Advanced leadership training pertaining to planning, organizing, supervising, and conducting military activities through experiential exercises.

AFAS 442. National Security Forces in Contemporary American Society. (3-0) Cr. 3. Yr. *Prereq: 342.* The military profession, civil-military interaction, framework of defense policy, formulation of defense strategy and management of conflict. Formulation and implementation of U.S. security policy. Regional studies, military law, and in-depth Air Force doctrine and organization. Analysis of civil-military interactions. Advanced leadership training pertaining to planning, organizing, supervising, and conducting military activities through experiential exercises.

American Indian Studies

(Interdepartmental Undergraduate Minor)

Program Acting Chair: Z. Zimmerman

The American Indian Studies Program is a cross-disciplinary program in the College of Liberal Arts and Sciences which offers an opportunity to learn more about the cultural heritage of American Indians, their historical relationship with non-Indians, and their participation in contemporary American society. This program emphasizes perspectives from American Indian Studies, anthropology, art, history, literature, political science, and sociology.

The courses in the American Indian Studies Program provide added background for students whose career interests may include multicultural education, human services, legal services, or public administration.

Within the College of Liberal Arts and Sciences, courses in American Indian studies can be used as electives, in a minor, or in an interdisciplinary studies major (for details, see *Index, Interdisciplinary Studies*). Students majoring in another college who wish to use these courses should consult with their advisers.

A minor in the College of Liberal Arts and Sciences must include at least 15 credits of courses in the field. A minor in American Indian studies must include 210, two courses chosen from among the following: 310, 322, 332 and 346, and two additional courses chosen from the program courses listed below. The American Indian Studies Program Committee will, upon application by the student and review of the program, certify that the student has completed a minor in American Indian Studies.

Because course offerings vary from year to year, any student interested in a minor in American Indian Studies should contact the American Indian Studies office for advising. (See *Index, LAS Cross-Disciplinary Programs*.)

Courses open for nonmajor graduate credit: 346.

Courses Primarily for Undergraduate Students

Am In 210. Introduction to American Indian Studies. (3-0) Cr. 3. F.S. Introduction to the multidisciplinary aspects of American Indian studies. Topics include literature, the arts, history, anthropology, sociology, education, and contemporary Indian politics. Guest lectures, media presentations, and discussion of assigned readings.

Am In 310. Topics in American Indian Studies. (3-0) Cr. 3 each time taken, maximum of 6. S. Issues within specific topical areas of American Indian society and culture, such as social work with Indian families, tribal government, and environmental policy.

Am In 315. Archaeology of North America. (Same as Anthr 315/515.) See *Anthropology*.

Am In 320. Cultural Continuity and Change on the Prairie-Plains. (Same as Anthr 320/520.) See *Anthropology*.

Am In 322. The American Indian. (Same as Anthr 322/523.) See *Anthropology*.

Am In 323. Peoples and Cultures of Latin America. (Same as Anthr 323/523.) See *Anthropology*.

Am In 332. American Indians Today. (Same as Anthr 332/532.) See *Anthropology*.

Am In 346. American Indian Literature. (Same as Engl 346.) See *English*. Nonmajor graduate credit.

Am In 490. Independent Study. Cr. var. *Prereq: 6 credits in American Indian studies; permission of instructor.* Designed to meet the needs of students who wish to study in areas other than those in which courses are offered. No more than 9 credits in Am In 490 may be counted toward graduation.

Courses Offered by Departments

Hist 370. History of Iowa. See *History*.

Hist 465. The American West. See *History*.

Pol S 312. Minicourse in American Government and Politics. See *Political Science*. Acceptable only when offered as a course in American Indian tribal government and political theory.

Soc 330. Ethnic and Race Relations. See *Sociology*.

Art H 380. North American Indian Art. See *Art and Design*.

Anthr 428. Archaeological Laboratory Methods and Techniques. See *Anthropology*.

Anthr 429. Archaeological Field School. See *Anthropology*.

C I 280C. Native American Tutoring. (Same as C I 280C.) See *Curriculum Instruction*.

Animal Ecology

Bruce W. Menzel, Chair of Department

Professors: Atchison, Best, Clark, Dinsmore, Downing, Franklin, Menzel, Summerfelt

Professors (Collaborators): Klaas

Distinguished Professors (Emeritus): Carlander

Professors (Emeritus): M. Bachmann, R. Bachmann, Moorman

Associate Professors: Danielson, Morris

Assistant Professors: Debinski, Pease

Assistant Professors (Collaborators): Hohman, Koford, Pierce

Undergraduate Study

The department offers work for the bachelor of science degree with a major in animal ecology (see *College of Agriculture, Curricula*). For further information visit our departmental home page at: <http://www.aecl.iastate.edu>

The animal ecology curriculum provides its majors with an understanding of ecological principles and processes and their applications to natural resource management. It is oriented toward students desiring a general and flexible program in environmental biology and for those planning graduate study. An option must be selected from aquaculture, ecology, fisheries, interpretation of natural resources, preveterinary and wildlife care, or wildlife. Graduates find employment as aquaculturists, wildlife biologists, fisheries biologists, and ecologists for industry, environmental consulting firms, natural resource and environmental agencies and organizations, zoos, and as educators.

Graduates of the Animal Ecology program understand the basic principles of animal biology, ecology and management, and relevant aspects of scientific communication, basic mathematics and sciences, computing applications, and personal and professional development. Six specific options prepare students for careers in Aquaculture, Ecology, Fisheries, Interpretation of Natural Resources, Preveterinary and Wildlife Care, and Wildlife. Each option has specific outcomes expectations that include (1) the scope of the specialization and its relationships to broader aspects of animal ecology, biotic resource management, and other allied scientific disciplines and professions, (2) career opportunities and requirements, and (3) knowledge and skills appropriate for employment at technical and practitioner levels in each discipline. Graduates are able to communicate and work

effectively in the multidisciplinary arena of ecology and natural resource management.

This curriculum requires three months of relevant work experience or study at a biological station prior to graduation. The latter may be accomplished at the university's affiliate field stations, Iowa Lakeside Laboratory at West Lake Okoboji, and Gulf Coast Research Laboratory at Ocean Springs, Mississippi. Information on these laboratories is available from the department's Student Services Center.

The department participates in interdisciplinary programs in biology, environmental studies, and pest management. By proper selection of free and restricted elective courses, students can obtain a minor or a secondary major in environmental studies or pest management.

Preveterinary medicine preparation may be achieved while satisfying degree requirements in animal ecology.

Additional education and training can lead to other opportunities in such areas as research and management, natural resources planning and administration, teaching, and environmental consulting, among others. Graduate training is necessary for many specialized positions within the fields of animal ecology. Majors preparing for graduate study should consult with their academic adviser concerning appropriate coursework.

Students seeking certification to teach biology in secondary schools must meet requirements of the College of Education as well as those of the Department of Animal Ecology. In addition, they must apply formally for admission to the teacher education program (see *Index, Teacher Education Program*). Students with an interest in careers in outdoor writing are encouraged to obtain a minor or a second major in journalism (see *Index, Journalism and Mass Communication, Courses and Programs*). Students who wish to pursue a job as a conservation officer may wish to minor in criminal justice (see *Index, Criminal Justice Studies*).

The Department of Animal Ecology provides several scholarships; application information is available in the departmental Student Services Center.

The department offers a minor in animal ecology that may be earned by taking 15 credits in the department including 120, 310, 311, 312 plus three additional credits of Animal Ecology courses at the 300 level or above.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in animal ecology, fisheries biology, and wildlife biology. Within these majors, the student may also specialize in animal behavior, aquaculture, ecology, or limnology. Students may also major in interdepartmental graduate majors in ecology and evolutionary biology, toxicology, or water resources (see *Index*).

Graduates have a broad understanding of the basic principles of animal biology, ecology and management, and relevant aspects of basic

mathematics and natural sciences, computing applications, and personal and professional development. They are able to execute rigorous independent research, have developed problem-solving and critical-thinking skills, and can communicate effectively with scientific colleagues and the general public in both formal and informal settings.

Personnel of the Biological Resources Division of the U.S. Geological Survey, through the Iowa Cooperative Fish and Wildlife Research Unit, and the Iowa Department of Natural Resources contribute to the graduate programs of the department.

No more than two dual-listed animal ecology courses may be applied for major graduate credit. Additional work is expected of students taking a dual-listed course for credit at the 500 level.

Courses open for nonmajor graduate credit: 350, 410, 410L, 413, 419I, 430, 451, 455.

Courses Primarily for Undergraduate Students

A Ecl 104. Practical Work Experience. Cr. R. Three months of relevant work experience or study at a summer biological station. See adviser for specific requirements.

A Ecl 110. Orientation in Animal Ecology. (2-0) Cr. R. F. First half semester. Orientation to the Animal Ecology department and curriculum, and to university life.

A Ecl 120. Introduction to Renewable Resources. (Same as Agron 120, AST 120, Env S 120, For 120.) (3-0) Cr. 3. F.S. Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

A Ecl 130. Wildlife and Agriculture. (2-0) Cr. 2. S. Survey of the ecology and management of fish and wildlife resources in areas of intensive agriculture, with emphasis on Iowa. Wildlife conservation and management practices for private agricultural lands. Designed for nonmajors.

A Ecl 211. Careers in Animal Ecology. (2-0) Cr. 1. F. Second half semester. *Prereq: Sophomore classification.* Career planning and opportunities in animal ecology. Offered on a satisfactory-fail grading basis only.

A Ecl 300. Seminar. (2-0) Cr. 1 each time taken; may be taken more than once for graduation credit. F.S. *Prereq: Permission of instructor.* Current topics in animal ecology, fisheries and wildlife biology, and environmental issues.

A Ecl 301I. Iowa Natural History. (Same as Bot 301I, Ia LL 301I, Zool 301I.) See *Iowa Lakeside Laboratory*.

A Ecl 303. Internship. Cr. 1 to 3. F.S.SS. *Prereq: Permission of instructor and sophomore standing.* Placement with county conservation boards, camps, zoos, parks, etc., for experience as interpreters, rangers, and technicians. A total of 6 credits may be used toward degree requirements.

A Ecl 303I. Undergraduate Internship. (Same as Ia LL 303I.) See *Iowa Lakeside Laboratory*.

A Ecl 310. Vertebrate Biology. (2-2) Cr. 3. F. *Prereq: Biol 202, 202L.* Evolution, biology, and classification of fish, amphibians, reptiles, birds, and mammals. Emphasis on a comparative analysis of the structure and function of organ systems. Laboratory exercises concentrate on morphology and identification of orders of vertebrates. Materials fee.

A Ecl 311. Vertebrate Biology. (2-2) Cr. 3. S. *Prereq: 310; Biol 312 recommended.* Ecology, physiology, biogeography, and behavior of fish, amphibians, reptiles, birds, and mammals. Emphasis on a comparative analysis of adaptations to particular environ-

ments. Laboratory exercises concentrate on species and families found in Iowa and the upper Midwest. Materials fee.

A Ecl 312. Ecology. (Same as Biol 312, Bot 312, EnSci 312.) See *Biology*.

A Ecl 312I. Ecology. (Same as Biol 312I, Bot 312I, EnSci 312I, Ia LL 312I, Zool 312I.) See *Iowa Lakeside Laboratory*.

A Ecl 321. Fish Biology. (Dual-listed with 521.) (2-3) Cr. 3. S. *Prereq:* 311. Anatomy, physiology, behavior, and ecology of fishes. Field trip fee, materials fee.

A Ecl 325. Bird Study. (0-3) Cr. 1. S. Classification and identification of birds emphasizing midwestern species. Field trip fee.

A Ecl 326I. Ornithology. (Same as Ia LL 326I.) See *Iowa Lakeside Laboratory*.

A Ecl 330. Interpretation of Natural Resources. (2-3) Cr. 3. S. *Prereq:* 6 credits in biological sciences. History, objectives, forms, and techniques of natural resources interpretation in the settings of county, state, and national parks. Field trip fee.

A Ecl 350. Ecological Methods and Analyses. (2-2) Cr. 3. S. *Prereq:* 120, 312; *Stat 101 or 104*. Quantitative techniques used in management of natural resources with emphasis on inventory and manipulation of habitat and animal populations. Materials fee. Nonmajor graduate credit.

A Ecl 410. Aquatic Ecology. (Same as EnSci 410.) (2-0) Cr. 2. F. *Prereq:* Biol 202, 202L; 312 recommended. Structure and function of aquatic ecosystems with application to management, fisheries, and pollution problems. Nonmajor graduate credit.

A Ecl 410L. Aquatic Ecology Laboratory. (Same as EnSci 410L.) (0-3) Cr. 1. F. *Prereq:* Concurrent enrollment in 410. Field trips and laboratory exercises to accompany 410. Hands-on experience with aquatic research and monitoring techniques and concepts. Materials fee, field trip fee. Nonmajor graduate credit.

A Ecl 413. Community Ecology and Management. (2-2) Cr. 3. S. *Prereq:* Biol 312. The effect of interspecific interactions on the structure and dynamics of natural and managed communities; including concepts of guild structure and trophic web dynamics and their importance to the productivity, diversity, stability, and sustainability of communities. The implications of interspecific interactions in the management of wild species will be emphasized with illustrative case histories of interactions between plants, invertebrates, and vertebrates. Nonmajor graduate credit.

A Ecl 419I. Vertebrate Ecology and Evolution. (Same as Ia LL 419I, Zool 419I.) See *Iowa Lakeside Laboratory*. Nonmajor graduate credit.

A Ecl 425. Aquatic Insects. (Dual-listed with 525; same as Ent 425.) See *Entomology*.

A Ecl 430. Media Techniques in Natural Resources Interpretation. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 330. Media techniques used by interpreters for teaching the public about natural resources. Field trip fee. Nonmajor graduate credit.

A Ecl 440. Fishery Management. (Dual-listed with 540.) (2-3) Cr. 3. F. *Prereq:* 120, 312; *credit or enrollment in 410; Stat 104*. Biological basis of fishery management, fishery problems, and management practices for freshwater, anadromous, and marine fisheries. Materials fee, field trip fee.

A Ecl 442. Aquaculture. (Dual-listed with 542.) (2-3) Cr. 3. S. *Prereq:* 410, *credit or enrollment in 321*. Concepts related to the culture of aquatic organisms including culture systems techniques, nutrition, genetics, and diseases. Field trip fee, materials fee.

A Ecl 451. Wildlife Management. (2-3) Cr. 3. F. *Prereq:* 350. Problems of managing wildlife habitat and populations. Case studies and group projects. Field trip fee. Nonmajor graduate credit.

A Ecl 455. International Wildlife Issues. (3-0) Cr. 3. S. *Prereq:* 120, 311, 312 or graduate standing. Biological, political, social, and economic factors affecting the management of international wildlife resources. Nonmajor graduate credit.

A Ecl 490. Independent Study. Cr. arr. F.S.SS.

Prereq: Junior or senior classification, 10 credits in biological sciences and permission of instructor. Student-initiated field, laboratory, or library project. A total of 6 credits may be used toward degree requirements.

A Ecl 490I. Undergraduate Independent Study. (Same as Ia LL 490I.) See *Iowa Lakeside Laboratory*.

A Ecl 493. Workshop. (1-0) Cr. 1. SS. *Prereq:* Permission of instructor. Ecological concepts and fishery and wildlife management practices for landowners and farm managers. Not for students majoring in animal ecology. May be taken more than once for graduation credit.

Courses Primarily for Graduate Students, open to qualified undergraduate students

A Ecl 500. Seminar. (2-0) Cr. 1 each time taken; may be taken more than once for graduation credit. F.S. *Prereq:* Permission of instructor or graduate classification. Current topics in ecological research, fish and wildlife management, and environmental problems related to fish or wildlife resources.

A Ecl 501. Field Seminar. (0-3 or 0-9) Cr. 1-3 each time taken. May be taken more than once for graduation credit. *Prereq:* 120 and permission of instructor. Extended field trips to areas such as national parks and wilderness areas to study ecological topics in forests, grasslands, deserts, wetlands, or coastal and marine systems. Field trip fee.

A Ecl 508I. Aquatic Ecology. (Same as EnSci 508I, Ia LL 508I.) See *Iowa Lakeside Laboratory*.

A Ecl 510. Histology and Pathology of Fish Diseases. (Same as Zool 510.) (2-3) Cr. 3. Alt. S., offered 2000. *Prereq:* A course in vertebrate histology or ichthyology. Histology of teleost fishes; pathogen biology and analysis of cell and tissue changes in the major teleost diseases. Materials fee.

A Ecl 513. Ecological Toxicology. (Same as EnSci 513, Tox 513.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* Biol 312. Effects of contaminants on aquatic and terrestrial ecosystems and community structure and processes. Environmental flow and fate of contaminants. Ecological risk assessment.

A Ecl 514. Evolutionary Ecology. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 588; Biol 303; graduate standing. Relationships between animals and their environment, with major emphasis on adaptive strategies and evolutionary mechanisms.

A Ecl 515. Ecology of Freshwater Invertebrates. (Same as Zool 515.) (1-6) Cr. 3. Alt. S., offered 2000. *Prereq:* Biol 312; *Stat 104*. Identification, natural history, and ecological relationships of free-living freshwater invertebrates. Emphasis on community structure, function and sampling techniques. Field trip fee, materials fee.

A Ecl 516. Avian Ecology. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 311, 312, graduate standing or permission of instructor. Current topics and theories including avian breeding and foraging ecology, community structure, habitat selection, field methodologies, and data interpretation. Strong evolutionary emphasis.

A Ecl 518. Stream Ecology. (Same as EnSci 518.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 410. Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

A Ecl 520. Fish Ecology. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 312, 321. Relationships of fish with biotic and abiotic components of their environment and the functional role of fish in stream, lake, reservoir and marine ecosystems. Course will focus on current conceptual developments and primary literature. Field trip fee.

A Ecl 520I. Fish Ecology. (Same as Ia LL 520I.) See *Iowa Lakeside Laboratory*.

A Ecl 521. Fish Biology. (Dual-listed with 321.) (2-3) Cr. 3. S. *Prereq:* 311. Anatomy, physiology, behavior and ecology of fishes. Field trip fee, materials fee.

A Ecl 525. Aquatic Insects. (Dual-listed with 425; same as Ent 525.) See *Entomology*.

A Ecl 531. Conservation Biology. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 312; Biol 301, graduate standing or permission of instructor. Examination of conservation issues from a population and a community perspective. Population-level analysis will focus on the role of genetics, demography, and environment in determining population viability. Community perspectives will focus on topics such as habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology. Field trip fee.

A Ecl 531I. Conservation Biology. (Same as Ia LL 531I.) See *Iowa Lakeside Laboratory*.

A Ecl 532. Human Dimensions of Wildlife Management. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* Biol 312 or equivalent plus 6 credits of biological sciences; permission of instructor. Exploration of institutions that help shape fish and wildlife management and policies. Current research on interaction of humans with wildlife resources. Roles of social forces, politics and economics in wildlife management.

A Ecl 540. Fishery Management. (Dual-listed with 440.) (2-3) Cr. 3. F. *Prereq:* 120, 312, *credit or enrollment in 410; Stat 104*. Biological basis of fishery management, fishery problems, and practices for management of freshwater, anadromous, and marine fisheries. Materials fee, field trip fee.

A Ecl 542. Aquaculture. (Dual-listed with 442.) (2-3) Cr. 3. S. *Prereq:* 410, *credit or enrollment in 321*. Concepts related to the culture of aquatic organisms including culture systems techniques, nutrition, genetics, and diseases. Field trip fee, materials fee.

A Ecl 544. Aquatic Toxicology. (Same as EnSci 544, Tox 544.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 410. Environmental chemistry and the biochemical, physiological, behavioral and population level effects of contaminants on aquatic organisms.

A Ecl 551. Wildlife Behavioral Ecology. (2-2) Cr. 3. Alt. S., offered 2000. *Prereq:* 312; a course in wildlife management recommended. Examination and synthesis of social organizational and behavioral concepts important for wildlife conservation. Game and non-hunted wildlife species of the world treated. Materials fee.

A Ecl 552. Restoration Ecology. (Same as EnSci 552.) (2-3) Cr. 3. F. *Prereq:* Bot 306 or 484; graduate standing or permission of instructor. Theory and practice of restoring animal and plant diversity, structure and function of disturbed ecosystems. Restored freshwater wetlands, forests, prairies and reintroduced species populations will be used as case studies. Field trip fee.

A Ecl 560. Ecological Resource Management. (2-3) Cr. 3. Alt. S., offered 2000. *Prereq:* Biol 202, 202L, 312; *Stat 101 or 104; graduate standing or permission of instructor*. Ecological and economical management of sustainable biological resources. Unifying current management concepts and models in wildlife, fisheries, water quality, forestry, recreation, and agriculture. Research problems.

A Ecl 570. Landscape Ecology. (Same as Bot 570.) (2-3) Cr. 3. Alt. F., offered 2000. *Prereq:* 588; permission of instructor; a course in calculus. The study of ecological and evolutionary processes within a spatial context with emphasis on behavior, population, and community dynamics. Field trip fee.

A Ecl 580. Research Methods in Ecology. (2-0) Cr. 2. F. *Prereq:* 20 credits in biological sciences and a course in statistics. Research design, proposal preparation, technical writing, and professional presentations.

A Ecl 588. Population Ecology. (Same as Bot 588.) (2-2) Cr. 3. F. *Prereq:* 312; *Stat 401; a course in calculus*. Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

A Ecl 590. Special Topics. Cr. arr. F.S.SS. *Prereq:* Graduate classification, permission of instructor. A total of 6 credits may be used toward degree requirements.

A Ecl 590I. Graduate Independent Study. (Same as la LL 590I.) See *Iowa Lakeside Laboratory*.

A Ecl 593. Workshop in Animal Ecology. Cr. 1 to 3. Prereq: 6 credits in biological sciences. May be taken more than once for graduation credit.

Courses for Graduate Students

A Ecl 600. Seminar. (2-0) Cr. 1 each time taken. May be taken more than once for graduation credit. F.S. Current topics in ecological research, fish and wildlife management, and environmental problems related to fish or wildlife resources.

A Ecl 611. Analysis of Populations. (2-2) Cr. 3. Alt. F., offered 1999. Prereq: 312; Stat 401; a course in calculus. Quantitative techniques for analyzing vertebrate population data to estimate parameters such as density and survival. Emphasis on statistical inference and computing.

A Ecl 698. Animal Ecology Teaching Practicum. Cr. 1 to 3 each time taken F.S.SS. Prereq: Graduate classification in animal ecology and permission of instructor. Graduate student experience in the animal ecology teaching program. Offered on a satisfactory-fail grading basis only.

A Ecl 699. Research.

A Ecl 699I. Research. (Same as la LL 699I.) See *Iowa Lakeside Laboratory*.

Courses Offered at the Gulf Coast Research Laboratory (GCRL), Ocean Springs, Mississippi

The Gulf Coast Research Laboratory is affiliated with the University of Southern Mississippi. Iowa State students may register for the following University of Southern Mississippi/GCRL courses and transfer them to their ISU degree programs. Written permission of the ISU coordinator for the GCRL, 201 Bessey, is required for this arrangement. Inquire at 201 Bessey for further information.

MAR 405. Marine Ecology. Cr. 3. SS. Prereq: 16 hours of biological sciences including general zoology, general botany, and invertebrate zoology. A consideration of the relationship of marine organisms to their environment, including the effects of temperature, salinity, light, nutrient concentration, currents, and food on their abundance and distribution.

MAR 405L. Marine Ecology Lab. Cr. 2. SS. Lab to accompany MAR 405.

MAR 406. Fauna and Faunistic Ecology of Tidal Marshes. Cr. 1. SS. Prereq: 16 hours of biological sciences and junior standing. Survey and discussion of the taxonomy, distribution, trophic relationships, reproductive strategies and adaptation of tidal marsh animals with emphasis on those occurring in northern Gulf marshes.

MAR 406L. Fauna and Faunistic Ecology of Tidal Marshes Lab. Cr. 3. SS. Lab to accompany MAR 406.

MAR 407. Marine Aquaculture. Cr. 3. SS. Prereq: General zoology or invertebrate zoology. A lecture, laboratory, and field course designed to introduce aquatic and marine biology students to the history, principles, problems, and procedures relating to the culture of commercially important crustaceans, fish, and mollusks along the Gulf Coast.

MAR 407L. Marine Aquaculture Lab. Cr. 3. SS. Lab to accompany MAR 407.

MAR 410. Marine Fisheries Management. Cr. 2. SS. A general course in fisheries management designed to acquaint students with the philosophy, objectives, problems, and principles involved in management decisions. Lectures will include specialists in biology, fisheries statistics, sanitation, and marine law.

MAR 410L. Marine Fisheries Management Lab. Cr. 2. SS. Lab to accompany MAR 410.

Animal Science

www.public.iastate.edu/~ans/

Dennis N. Marple, Head of Department

Distinguished Professors: Anderson, Beitz, Freeman, Sell, Trenkle

University Professors: Kenealy, Parrish, Sebranek

Professors: Berger, Brant, Ewan, Fernando, Ford, Hoffman, Holden, Jurgens, Kilmer, Lamont, Loy, Marple, Morriscal, Nissen, Olson, Prusa, Robson, Rothschild, Rouse, Russell, Scanes, Spike, Stahly, Strohhahn, Stromer, Topel, Wilson, Young, Zimmerman

Professors (Collaborators): Acker, Horst, Reinhardt

Distinguished Professors (Emeritus): Jacobson, Willham

Professors (Emeritus): Brackelsberg, Foreman, Haynes, Kiser, Nordskog, Owings, Rust, Self, Speer, Stevermer, Voelker, Warner, Wickersham, Wunder, Zmolek

Associate Professors: Auwerda, Cordray, Dekkers, Dickson, Faust, Honeyman, Huiatt, Skaar, Timms, Tuggle, Tyler, Youngs

Associate Professors (Collaborators): Goff, Kehrl, Nonnecke

Assistant Professors: Ahn, Baas, Lay, Lindberg, E. Lonergan, S. Lonergan, Powers-Schilling, Reecy

Assistant Professors (Adjunct): Ramsey

Assistant Professors (Collaborators): Rasmussen, Rathmacher

Undergraduate Study

Graduates will be able to solve the complex problems of animal enterprise management and will understand the global perspective of agriculture and their part in a world market. Graduates will have acquired the technical knowledge and application skills to be competent in their chosen field and to be a lifelong learner in their profession. Graduates will be able to identify the issues impacting their industry and be aware of methods of addressing these issues. They will have developed integrative problem solving skills desired by their potential employers and required for success in career and personal development. They will possess the communications, team building, and leadership skills which allow them to attain positions of responsibility and leadership within their career field. Those students who wish to pursue graduate studies or professional programs, such as veterinary medicine, can enroll in required coursework to prepare for application.

For undergraduate curricula in animal science and dairy science, see *College of Agriculture, Curricula*. Visit our web site at: www.iastate.edu/ans/ugrad/

The department offers the degrees bachelor of science in animal science, bachelor of science in dairy science, and complementary work toward admission to schools of law, medicine, and veterinary medicine in either curriculum. This may be done while satisfying requirements for the degree bachelor of sci-

ence in animal science or dairy science (see *Index*).

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in animal breeding; animal nutrition; meat science; muscle biology; nutritional physiology; physiology of reproduction; and molecular, cellular, and developmental biology. Minor work is offered in these areas to students taking major work in other departments. For students desiring more general training, the degree master of science is offered in animal production. In this program, additional coursework and a creative component may be substituted for a thesis.

A strong undergraduate program is required for those students interested in graduate study. Fundamental training in biology, chemistry, mathematics, and statistics is requisite to a satisfactory graduate program. Graduate programs in animal science include supporting work in areas such as agronomy; anatomy; microbiology; biochemistry; chemistry; economics; food science and human nutrition; genetics; physics; physiology; and statistics. Students may choose graduate programs involving a co-major with one of these areas. Graduate work in meat science is offered as a co-major in animal science and food science and human nutrition.

The department also cooperates in the interdepartmental program in professional agriculture and interdepartmental majors in genetics, immunobiology, MCDB (molecular, cellular, and developmental biology), and toxicology (see *Index*).

The foreign language requirement, if any, is established on an individual basis by the program-of-study committee appointed to guide the work of the student.

Courses open for nonmajor graduate credit: 319, 331, 352, 353, 360, 415, 419, 423, 424, 425, 426, 429, 434, 470, 493.

Courses Primarily for Undergraduate Students

An S 110. Orientation in Animal Science and ISU. (1-0) Cr. R. F. Orientation to the university and Department of Animal Science. Challenges and opportunities available to the professional animal agriculturalist. Professional goal setting, portfolio development, and development of interpersonal skills in the context of pursuing a career in animal science.

An S 114. Survey of the Animal Industry. (2-0) Cr. 2. F.S.SS. Ways domestic animals serve the basic needs of humans for food, shelter, protection, fuel, and emotional well-being. Terminology, basic structures of the industries surrounding the production, care, and marketing of domestic animals in the U.S.

An S 114L. Working with Animals. (0-3) Cr. 1. F.S. Prereq: Credit or concurrent enrollment in 114. A hands-on introductory course in skills for proper care and management of domestic animals. Husbandry skills including health observation, animal movement, identification, management procedures, and environmental assessment are covered.

An S 115. Horsemanship and Equitation. (0-4) Cr. 1. F.S.SS. Beginning and intermediate English equitation and western horsemanship. Materials fee.

An S 211. Issues Facing Animal Science. (0-2) Cr. 1. F.S. Prereq: 114, sophomore classification.

Overview of the factors that define contemporary ethical and scientifically based issues facing animal agriculture. Life skill development (including interactive skills, communication ability, organization, information gathering, and leadership skills) emphasized in the context of issues study.

An S 214. Domestic Animal Physiology. (3-0) Cr. 3. F.S. *Prereq:* *Biol 201, Chem 163 or 177.* Introduction to anatomy and physiology of the neural, circulatory, respiratory, immune, endocrine, reproductive, and digestive systems of domestic animals.

An S 214L. Domestic Animal Anatomy and Physiology Lab. (0-2) Cr. 1. F.S. *Prereq:* *Concurrent enrollment in An S 214.* Basic anatomy of domestic animals.

An S 216. Equine Science. (2-2) Cr. 3. S. *Prereq:* *Course in biology.* Introduction to contemporary concepts, and basic practices and decisions necessary when managing horses through stages of their lives. Field trip fee, materials fee.

An S 224. Companion Animal Science. (2-2) Cr. 3. S. *Prereq:* *Course in biology.* Introduction of students to contemporary concepts, and basic practices and decisions necessary when caring for the companion animal through stages of its life. Field trip fee.

An S 235. Dairy Cattle Performance. (1-2) Cr. 2. F. *Prereq:* *114.* Origin and development of breeds. Improvement and expansion programs. Comparison of types and performance. Influences affecting commercial use and adaptability of types and breeds. Marketing of dairy cattle and milk.

An S 250. Food Animal Science. (2-2) Cr. 3. F.S. *Prereq:* *114, 114L; course in biology.* Introduction to contemporary practices and decisions necessary when managing beef, dairy, poultry, sheep and swine through stages of their respective production cycles.

An S 270. Foods of Animal Origin. (2-2) Cr. 3. F.S. *Prereq:* *Biol 201, Chem 163 or 177.* Principles, practices and issues impacting the production, processing and preservation of safe, wholesome, nutritious, and palatable meat, dairy, and egg products. Product evaluation, classification, value, and utilization.

An S 305. Livestock Evaluation. (0-6) Cr. 3. F.S. *Prereq:* *Junior classification; 250, 270 recommended. Fall semester leads to 475A or D.* Breeding animal and market animal evaluation of beef, swine and sheep using contemporary techniques and tools. Communication and decision-making skills are practiced in the context of making selection decisions. Field trip fee.

An S 311. Career Preparation in Animal Science. (0-2) Cr. 1. F.S. *Prereq:* *Junior classification in An S.* Life skill development emphasized in the context of career preparation. Assist students with career goal clarification, interview skills, resume preparation. Internship development, job shadowing, and exploration of career option. Offered on a satisfactory-fail grading basis only.

An S 313. Exercise Physiology of Animals. (2-0) Cr. 2. F. *Prereq:* *214, Biol 201, one course in chemistry.* Interaction of physiological development relative to athletic performance in domestic animals, primarily equine performance.

An S 316. Training the Horse. (1-4) Cr. 3. F. *Prereq:* *216, 313.* Modifying the behavior of the horse for performance objectives through biting, longeing, saddling, and riding. Materials fee.

An S 319. Animal Nutrition. (2-2) Cr. 3. F.S.SS. *Prereq:* *214, course in organic chemistry or biochemistry.* Fundamentals of nutrition. Essential nutritive requirements of domestic animals, sources of nutrients, composition and identification of feeds, diet formulation and feeding recommendations. Nonmajor graduate credit.

An S 320. Livestock Feeding Program Design. (0-4) Cr. 2. F.S. *Prereq:* *319.* Advanced diet formulation and feeding recommendations. Evaluation of alternate feeding programs and diets in the context of case studies.

An S 331. Animal Reproduction. (3-0) Cr. 3. F.S. *Prereq:* *Course in physiology.* Comparative anatomy,

physiology, and endocrinology of animal reproduction. Techniques for the control and manipulation of reproductive processes. Nonmajor graduate credit.

An S 332. Laboratory Methods in Animal Reproduction. (0-4) Cr. 2. F.S. *Prereq:* *Credit or enrollment in 331.* Comparative reproductive anatomy with emphasis on the physiology of normal reproductive function; ways to control and improve reproduction; principles of artificial insemination in farm animals; and selected laboratory exercises with written report.

An S 333. Embryo Transfer and Related Technologies. (2-0) Cr. 2. F. *Prereq:* *331 or 332.* Application of embryo transfer and related technologies to genetic improvement of mammalian livestock. Techniques for control of female reproduction, embryo collections and transfer, embryo cryopreservation, and embryo manipulation. Economic and genetic aspects of embryo transfer.

An S 334. Embryo Transfer Laboratory. (0-2) Cr. 1. F. *Prereq:* *Credit or concurrent enrollment in 333.* Selected laboratory exercises related to embryo transfer such as superovulation, embryo evaluation, microscopy, aseptic techniques, in vitro fertilization, and embryo manipulation technologies will be demonstrated and/or performed. Materials fee.

An S 335. Dairy Cattle Selection. (0-6) Cr. 2. S. *Prereq:* *Sophomore classification.* Selection of breeding animals for dairy herds. Comparative terminology, decision making, and presentation of oral reasons. Trips to dairy cattle farms. Livestock handling. Field trip fee.

An S 336. Domestic Animal Behavior and Well Being. (2-2) Cr. 3. F. *Prereq:* *One course in physiology.* Principles of behavior relative to animal care, management and environmental design to ensure animal well-being. Examination of basic neural-endocrine mechanisms involved in the animal's response to its environment.

An S 337. Lactation. (2-0) Cr. 2. S. *Prereq:* *214.* The structure, development and evolution of the mammary gland. Mammary metabolism, milk synthesis; neural and endocrine regulation of mammary function. Immune function and health of the mammary gland.

An S 345. Growth Related to Value Based Marketing. (2-2) Cr. 3. S. *Prereq:* *214, 270.* Application of principles of growth and development related to value based marketing. Postnatal growth and development of fat, muscle and bone of food animals. Techniques to evaluate carcass composition and value.

An S 352. Livestock Improvement Through Animal Breeding. (0-4) Cr. 3. F.S.SS. *Prereq:* *One course in statistics, Biol 201, course in genetics.* Principles of qualitative and quantitative genetics applied to creating change in domestic animals. Impact of selection and mating schemes in achieving breeding program goals. Applications and impacts of biotechnological advancements in genetic manipulation. Nonmajor graduate credit.

An S 353. Animal Breeding Programs Design. (0-4) Cr. 2. S. *Prereq:* *352.* Evaluation of alternate breeding programs and genetic improvement techniques in the context of case study. Experiential and cooperative learning techniques employed. Field trip fee. Nonmajor graduate credit.

An S 360. Fresh Meats. (2-2) Cr. 3. F. *Prereq:* *270; course in organic or biochemistry.* Impact of muscle structure, composition, rigor mortis, inspection, fabrication, handling, packaging and cooking on the palatability, nutritional value, yields, market value, and safety of fresh meat. Hands-on cutting and processing lab. Field trip fee. Nonmajor graduate credit.

An S 371. Meat for Food Service. (1-2) Cr. 2. S. *Prereq:* *270 or FS HN 211.* Meat and poultry for hotel, restaurant, and institutional use. Structure, composition, cutting, preparation, selection, sanitation, portion control, cooking and carving. Materials fee.

An S 399. Animal Science Internship. Cr. 2 to 6. F.S.SS. Practical experience related to animal science. Creative component.

An S 411. Addressing Issues in Animal Science. (0-2) Cr. 1. F.S. *Prereq:* *Senior classification in An S.* Life skill development emphasized in the context of exploring one's perspective of the most pressing moral and scientific issues facing animal agriculture. Clarification and communication of personal conclusions in small and large group settings expected.

An S 415. Equine Systems Management. (2-2) Cr. 3. S. *Prereq:* *216, 319, 331.* Application of advanced horse management techniques. Advertising and business management practices. Computer-aided management of a commercial horse operation. Explore topics of current concern in the horse industry. Computer aided study. Field trip fee. Nonmajor graduate credit.

An S 419. Advanced Animal Nutrition. (2-0) Cr. 2. F. *Prereq:* *214, 319.* Detailed consideration of digestion, metabolism, and assimilation of nutrients. Recent advances and developments in basic nutrition. Nonmajor graduate credit.

An S 423. Poultry Systems Management. (2-2) Cr. 3. F. *Prereq:* *319, 331, 352.* Decisions facing the administrator of a poultry enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the poultry enterprise. Computer aided study. Field trip fee. Nonmajor graduate credit.

An S 424. Companion Animal Systems Management. (2-2) Cr. 3. S. *Prereq:* *224, 319, 331, 352.* Decisions facing the administrator of a companion animal enterprise. Financial and business goal identification, problem clarification, and resource allocation to manage the companion animal system. Field trip fee. Nonmajor graduate credit.

An S 425. Swine Systems Management. (2-2) Cr. 3. F.S. *Prereq:* *270, 319, 331, 352.* Decisions facing the administrator of a swine enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the swine enterprise. Computer aided study. Field trip fee. Nonmajor graduate credit.

An S 426. Beef Cattle Systems Management. (2-2) Cr. 3. F.S. *Prereq:* *270, 319, 331, 352.* Decisions facing the administrator of a beef cow-calf or feedlot enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the beef enterprise. Computer aided study. Field trip fee. Nonmajor graduate credit.

An S 429. Sheep Systems Management. (2-2) Cr. 3. S. *Prereq:* *270, 319, 331, 352.* Decisions facing the administrator of a sheep enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the sheep enterprise. Computer aided study. Field trip fee. Nonmajor graduate credit.

An S 434. Dairy Systems Management. (2-2) Cr. 3. F.S. *Prereq:* *319, 331, 352.* Decisions facing the administrator of a dairy enterprise. Financial and production goal identification, problem clarification, and resource allocation to manage the dairy enterprise. Computer aided study. Field trip fee. Nonmajor graduate credit.

An S 440. Computer Applications. (2-0) Cr. 2. S. *Prereq:* *319, 331, 352.* Introduction to electronic spreadsheets, database management, computer communications and other approaches to problems in animal science. Beginning elements of livestock systems analysis.

An S 451. Animal Molecular Biology. (Dual-listed with 551.) (2-3) Cr. 3. F. *Prereq:* *352, BBMB 221 or organic chemistry, Biol 301.* Introduction to use of molecular biology techniques in domestic animal research and production. Restriction endonuclease mapping, gene mapping, gene cloning, DNA sequencing and amplification, and analysis of genetic differences at the molecular level. Materials fee.

An S 470. Processed Meats. (2-2) Cr. 3. S. *Prereq:* *270.* Physical, chemical and biological properties of meat important to processed meat product characteristics. Ingredients, technology and equipment used for cured meats, loaf products and fresh, cooked, dry and semi-dry sausages products. Field trip fee. Nonmajor graduate credit.

An S 475. Intercollegiate Judging Training and Competition. A, B, C, E: Cr. 1 to 5. May be repeated. F.S. D: Cr. 2. S. *Prereq:* Admission by invitation. Special topics in Animal Science. Field trip fee.

- A. Meat Animals
- B. Dairy Cattle
- C. Meats
- D. Meat Animal Evaluation. Specialized training in evaluating and grading live animals and carcasses.
- E. Horses

An S 490. Independent Study. Cr. 1 to 3. F.S.SS. *Prereq:* Permission of the instructor. A maximum of 6 credits of 490 may be used toward the total of 128 credits required for graduation. Open to juniors and seniors in animal science and dairy science showing satisfactory preparation for problems chosen. Individual topic conference and preparation of report. Field trip fee; materials fee.

- A. Animal Science
- B. Dairy Science
- C. Meat Science
- D. Senior Seminar
- G. Poultry Science
- F. Honors

An S 493. Workshop in Animal Science. (Dual-listed with 593.) Cr. 1 to 3. May be repeated. Offered as demand warrants. *Prereq:* Permission of instructor. Workshop in livestock production. Includes current concepts in breeding, nutrition, reproduction, meats, and technologies that impact the animal industry. Nonmajor graduate credit.

An S 495. Agricultural Travel Course Preparation. (0-1) Cr. R. May be repeated. F.S. *Prereq:* Permission of instructor. Limited enrollment. Students enrolled in this course will also register for Agron 495 and intend to register in Agron 496 and An S 496 the following term. Topics will include the agricultural industries, climate, crops, culture, history, livestock, marketing, soils, and preparation for travel to locations to be visited. Information normally available 9 months before departure.

An S 496. Agricultural Travel Course. Cr. arr. May be repeated. (approx. one-half credit per week traveled in each An S 496 and Agron 496). *Prereq:* Permission of instructor, 30 college credits. Limited enrollment. Students enroll in both An S 496 and Agron 496. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on livestock and crop production. Locations and duration of tours will vary. Summer tour will usually visit a northern location and winter tour will usually visit a southern location. Information usually available 9 months before departure. Tour expenses paid by students. Field trip fee.

- A. International tour
- B. Domestic tour

Courses Primarily for Graduate Students, open to qualified undergraduate students

An S 500. Computer Techniques for Biological Research. (5-0) first 3 weeks. Cr. 1. F. *Prereq:* Stat 401. Quick start computing techniques for solving research problems. Organization of data and transfer of files on workstations. Programming SAS, developing models, and techniques for analysis of designed experiments.

An S 501. Survey of Animal Science Disciplines. (1-0) Cr. 1. S. Required for Animal Science graduate students. Discussion of programs of research and outreach in Animal Science. Issues impacting the animal industry. Offered on a satisfactory-fail grading basis only.

An S 503. Seminar in Animal Production. (1-0) Cr. 1. May be repeated. F. *Prereq:* Permission of instructor. Discussion and evaluation of current topics in animal production and management.

An S 505. Introductory Techniques in Nutrition Experimentation. (2-3) Cr. 3. Alt. S., offered 2001. *Prereq:* Stat 401. Planning, execution, interpretation, and communication of nutrition research.

An S 510. Applied Animal Breeding. (2-0) Cr. 2. Off campus, offered as demand warrants. *Prereq:* 352,

Stat 493. Principles of animal breeding; application to improvement of domestic animals. Heritability, genetic and phenotypic correlations, selection index, sire and dam evaluation, and breeding program design. Designed for master of agriculture program.

An S 511. Applied Ruminant Nutrition. (2-0) Cr. 2. Off campus, offered as demand warrants. *Prereq:* 319. Procedures and theories in beef, dairy, and sheep nutrition. Feeding programs and requirements for lactation, growth, and reproduction. Designed for master of agriculture program.

An S 512. Applied Non-Ruminant Nutrition. (2-0) Cr. 2. Off campus, offered as demand warrants. *Prereq:* 319. Recent developments and application of basic nutritional concepts for swine and poultry production. Selected aspects and concepts of computer diet formulation. Designed for master of agriculture program.

An S 518. Digestive Physiology and Metabolism of Non Ruminants. (3-0) Cr. 3. F. *Prereq:* 319. Digestion and metabolism of nutrients. Nutritional requirements and current research and feeding programs for poultry and swine.

An S 519. Digestive Physiology and Metabolism of Ruminants. (2-2) Cr. 3. S. *Prereq:* 319. Digestive physiology and nutrient metabolism in ruminant and preruminant animals.

An S 533. Physiology and Endocrinology of Animal Reproduction. (2-0). Cr. 2. Alt. S., offered 2001. *Prereq:* General physiology course. Development of structure and function of the reproductive system. Physiologic and endocrine aspects including puberty, gametogenesis, estrous cycle, pregnancy, parturition, interaction of environment, thyroid and adrenal function, and nutrition with these processes.

An S 536. Perinatology. (3-0) Cr. 3. S. *Prereq:* One course in physiology. Regulation of metabolism and development in the mammalian fetus and neonate will be explored in a comparative manner. Emphasis will be on the dynamic changes in these relationships at birth. Classes will incorporate maximal student participation and development of critical thinking skills.

An S 540. Livestock Immunogenetics. (Same as Micro 540.) (2-0) Cr. 2. Alt. S., offered 2001. *Prereq:* 550 or Micro 520. Basic concepts and contemporary topics in genetic regulation of livestock immune response and disease resistance.

An S 547. Biological Applications of Microscopy. (Same as FS HN 547.) (2-0) Cr. 2. Alt. S., offered 2001. *Prereq:* 6 credits in biological science, permission of instructor. Principles and types of information obtained from light and electron microscopy techniques. Photomicrography and photomacrography. Demonstrations and structural data analysis with various biosystems.

An S 549. Advanced Vertebrate Physiology I. (Same as BMS 549.) See *Biomedical Sciences*.

An S 551. Animal Molecular Biology. (Dual-listed with 451.) (2-3) Cr. 3. F. *Prereq:* 352, BBMB 221 or organic chemistry, Biol 301. Introduction to use of molecular biology techniques in domestic animal research and production. Restriction endonuclease mapping, gene mapping, gene cloning, DNA sequencing and amplification, and analysis of genetic differences at the molecular level.

An S 556. Current Topics in Genome Analysis. (2-0) Cr. 2. Alt. S., offered 2000. *Prereq:* Biochem 405 or Gen 510. Introduction to principles and methodology of molecular genetics useful in analyzing and modifying large genomes. Survey of statistical methods and computer programs for bioinformatics, linkage mapping, radiation hybrid mapping, and mapping quantitative trait loci.

An S 561. Population and Quantitative Genetics for Breeding. (Same as Agron 561.) (4-0) Cr. 4. F. *Prereq:* Stat 401. Population and quantitative genetics for plant and animal breeding. Forces that change gene frequency, covariance between relatives, response to selection, artificial selection, estimation of variance components, inbreeding depression, heterosis, cross-breeding, genotype-by-environment

interaction, introduction to quantitative genetics loci mapping.

An S 562. Methodologies for Population/Quantitative Genetics. (4-0) Cr. 4. S. *Prereq:* 561, Stat 402. Basic methods for research and application of theory in animal breeding. Sources and types of data. Development of models for estimation and prediction. Estimation of variance components, heritability, and genetic correlations. Genetic prediction of animal merit. Techniques for using sources of relative information.

An S 570. Advanced Meat Science and Applied Muscle Biology. (2-2) Cr. 3. S. *Prereq:* 470. Chemistry and microscopic structure of muscle tissue. Post-mortem changes in muscle and their relationship to muscle as a food. Palatability and processing characteristics and factors affecting these characteristics. Laboratory practice and experimentation.

An S 571. Advanced Meat Processing Principles and Technology. (2-2) Cr. 3. F. *Prereq:* 470 or 570. Physical/chemical relationships during processing. Effects of modern technology, non-meat additives and preservation techniques on quality and safety of processed meat. Laboratory demonstration of principles and technology. Field trip fee.

An S 580. Sustainable Agriculture Seminar. (Same as A E 580, Ent 580, For 580) (1-0) Cr. 1. May be repeated. S. Issues, opportunities, and research associated with production systems for sustainable agriculture.

An S 590. Special Topics. Cr. 1 to 3. F.S.SS. *Prereq:* Permission of instructor. Special topics in the animal sciences, offered on demand and may be conducted by guest professors.

- A. Animal Breeding
- B. Animal Nutrition
- C. Meat Animal Production
- D. Dairy Production
- E. Meat Science
- F. Physiology of Reproduction
- G. Muscle Biology
- H. Poultry Nutrition
- I. Poultry Products
- J. Experimental Surgery
- K. Professional Topics

An S 593. Workshop in Animal Science. (Dual-listed with 493.) Cr. 1 to 3. May be repeated. Offered as demand warrants. *Prereq:* Permission of instructor. Graduate workshops in animal science and the technologies that impact the animal industry.

Courses for Graduate Students

An S 603. Seminar in Animal Nutrition. (1-0) Cr. R. May be repeated. F.S. *Prereq:* Permission of instructor. Discussion of current literature; preparation and submission of abstracts.

An S 618. Advanced Nutrition and Metabolism—Minerals and Vitamins. (Same as FS HN 618.) (3-0) Cr. 3. Alt. F., offered 2001. *Prereq:* BBMB 405. Role of vitamins and minerals in mammalian intermediary metabolism. Integration of cellular biochemistry and physiology of vitamins and minerals.

An S 619. Advanced Nutrition and Metabolism—Protein. (2-0) Cr. 2. Alt. F., offered 2001. *Prereq:* BBMB 405. Digestion, absorption, and intermediary metabolism of amino acids and protein. Regulation of protein synthesis and degradation. Integration of cellular biochemistry and physiology of mammalian protein metabolism.

An S 620. Advanced Nutrition and Metabolism—Energy. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* BBMB 405. Energy constituents of feedstuffs and energy needs of animals as related to cellular biochemistry and physiology. Interpretations of classical and current research.

An S 633. Seminar in Animal Reproduction. (1-0) Cr. 1. May be repeated. F. *Prereq:* Permission of instructor. Discussion of current literature and preparation of reports on selected topics concerning physiology of reproduction.

An S 652. Animal Breeding Strategies. (3-0) Cr. 3. F. *Prereq:* 562. Basic concepts, methods, and advanced topics in design, evaluation, economics,

and optimization of genetic improvement programs for livestock populations.

An S 653. Applied Poultry and Swine Breeding. (2-0) Cr. 2. Alt. S., offered 2001. *Prereq:* 651. Industrial applications of breeding systems, selection methods, and new genetic technologies.

An S 654. Applied Beef and Dairy Cattle Breeding. (2-0) Cr. 2. Alt. S., offered 2000. *Prereq:* 651. Industrial application of breeding systems, sire selection and evaluation, and crossbreeding.

An S 656. Statistical Methods for Mapping Quantitative Trait Loci. (2-0) Cr. 2. Alt. S., offered 2000. *Prereq:* 562, Stat 447. Statistical methods for mapping quantitative trait loci in out-bred populations. Methods based on modeling covariances between relatives. Likelihood based methods using half-sib and full-sib families and extended pedigrees. Bayesian methods applied.

An S 657. Statistical Component Estimation in Animal Breeding. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 652. Methods of genetic parameter estimation useful in animal breeding, including maximum likelihood, restricted maximum likelihood, and MIVQUE. Emphasis on application and computing strategies.

An S 658. Seminar in Animal Breeding and Genetics. (1-0) Cr. 1. May be repeated. F.S. *Prereq:* Permission of instructor. Discussion of current research, recent publications, and seminars by visiting scientists.

An S 670. Molecular Biology of Muscle. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* BBMB 405, 420, or 502. Ultrastructure of muscle; chemistry, structure, function, and molecular biology of muscle proteins. Molecular aspects of muscle contraction, development and turnover. Cytoskeletal proteins and dynamics.

An S 680. Modern Views of Nutrition. (Same as FS HN 680.) (2-0) Cr. R. May be repeated. S. Current concepts in nutrition and related fields. Required for all graduate students in nutrition.

An S 684. Seminar in Meat Science. (1-0) Cr. 1. May be repeated. S. *Prereq:* Permission of instructor. Discussion and evaluation of current topics in research publications in meat science.

An S 685. Seminar in Muscle Biology. (1-0) Cr. 1. May be repeated. S. *Prereq:* Permission of instructor. Reports and discussion of recent literature and current investigations.

An S 698. Seminar in Molecular, Cellular, and Developmental Biology. (Same as MCDB 698.) See *Molecular, Cellular and Developmental Biology.*

An S 699. Research.
A. Animal Breeding
B. Animal Nutrition
C. Meat Animal Production
D. Dairy Production
E. Meat Science
F. Physiology of Reproduction
G. Muscle Biology
H. Poultry Nutrition
I. Poultry Products

Anthropology

Michael B. Whiteford, Chair of Department

Professors: Huang, Whiteford

Professors (Emeritus): Bower, Gradwohl, Rahman

Associate Professors: Tiffany, Wolff

Associate Professors (Collaborators): Lange

Associate Professors (Emeritus): Schuster

Assistant Professors: Coinman, Steadman, Wagner

Instructors (Adjunct): Johnsen, Nepstad-Thornberry

1999-2001

Undergraduate Study

An undergraduate major in anthropology can serve as the nucleus for a general liberal education, or as the prerequisite for graduate training qualifying a person for positions in (1) college and university teaching, (2) research, and (3) administrative and applied positions in government, development organizations, museums, and private businesses or corporations.

Anthropology graduates develop a well-rounded professional education in four fields of anthropology: cultural anthropology, linguistic anthropology, archaeology, and biological anthropology. They learn what it means to be human through the study of culture and social relations, human biology and evolution, languages, music, art, architecture, and through the study of past human communities. Graduates learn the important historical and contemporary issues of our subdisciplines, and they learn what it means to be a "modern" anthropologist and a citizen in an international and global community. Graduates develop an appreciation of the value of cultural diversity at the local, national and international level. They acquire a particular holistic vision that requires using a repertoire of methods in order to forge a deeper understanding of cultural contexts, both past and present. Undergraduate students may obtain experience in archaeological and ethnological research.

Anthropology majors may choose either a bachelor of arts or a bachelor of science degree, both of which require 33 credits in anthropology. A bachelor of arts degree is obtained by fulfilling the college general education requirements plus 6 additional credits in Groups I, II, and/or IV. A bachelor of science degree is obtained by fulfilling the college general education requirements plus 6 additional credits in Group III.

Undergraduate students with majors in anthropology are required to take the following anthropology core courses: 306, 307, 308, and 309. One course in statistics and one course in computer science are required.

Undergraduates majoring in anthropology are required to have a minor or a second major. A minor usually consists of 15 credits minimum. A minor in anthropology consists of at least 15 credits and must include 306 or 309 and 307 or 308, and at least 6 other credits in courses numbered 300 or above.

English proficiency requirement: The department requires that a student earn a grade of C or better in Engl 105 and either English 302 or 309 or 314.

The principal subdisciplines of anthropology are represented by the following:

1. General cultural anthropology and ethnology: 201, 257, 306, 311, 312, 313, 317, 322, 323, 325, 326, 332, 333, 339, 340, 431, 450, 490B.
2. Archaeology: 202, 308, 314, 315, 320, 321, 416, 428, 429, 490A.
3. Linguistic anthropology: 309, 490D.

4. Biological anthropology: 202, 307, 319, 490C.

Graduate Study

The department offers the degree master of arts with a major in anthropology. Graduate courses are offered in the areas of biological anthropology, archaeology, cultural anthropology, linguistic anthropology, history and theory, and methodology. Competence in one foreign language and in statistics is to be demonstrated. A thesis, generally based on original fieldwork, is required.

Courses open for nonmajor graduate credit: 427I.

Courses Primarily for Undergraduate Students

Anthr 201. Introduction to Cultural Anthropology. (3-0) Cr. 3. F.S.SS. Comparative study of culture as key to understanding human behaviors in different societies. Using a global, cross-cultural perspective, patterns of family life, economic and political activities, religious beliefs, and the ways in which cultures change are examined.

Anthr 202. Introduction to Biological Anthropology and Archaeology. (3-0) Cr. 3. F.S. Human biological and cultural evolution; survey of the evidence from fossil forms and archaeology, as well as living primates and traditional cultures; introduction to methods of study in archaeological and biological anthropology.

Anthr 257. Introduction to Museums. (Same as T C 257.) (3-0) Cr. 3. F. *Prereq:* Sophomore standing. History and theory of museums. Overview of museum in modern society, careers in museum and future needs. Field trip fee.

Anthr 306. Comparative Studies of World Cultures. (3-0) Cr. 3. S. *Prereq:* 201 recommended. A survey of similarities and differences in the world's major societal types; examination of social institutions in hunting-and-gathering, agricultural, pastoral, and industrial societies; techniques of cross-cultural comparison.

Anthr 307. Biological Anthropology. (2-2) Cr. 3. S. *Prereq:* 202 recommended. Human evolution as known from fossil evidence, comparative primate studies, and genetic variations in living populations. Laboratory-tutorial sessions include study and discussion of human osteology, fossil hominids, simple Mendelian traits, and bio-ethics in applied biological anthropology.

Anthr 308. Archaeology. (2-2) Cr. 3. F. *Prereq:* 202. Methods and techniques for the recovery and interpretation of archaeological evidence, its role in reconstructing human behavior and past environments. Laboratory sessions include experience in the interpretation of archaeological evidence, the use of classification systems, and prehistoric technologies such as ceramics and stone tools. Field trips. Materials fee.

Anthr 309. Linguistic Anthropology. (Same as Ling 309.) (2-2) Cr. 3. F. *Prereq:* 201 recommended. Language as a human attribute; language versus animal communication; human communication in cultural context; paralinguistics, kinesics, proxemics, artifacts as communication; language and culture; cross-cultural sociolinguistics; ethnosociology; and language policies. Participatory lab: focus on analysis of a non-Western language and communication system.

Anthr 311. Culture Change and Applied Anthropology. (Dual-listed with 511.) (3-0) Cr. 3. F. *Prereq:* 201 or 306. Theoretical and practical considerations of human cultural development. Examination of theories of cultural change, culture contact and acculturation. Dynamics of directed change in contemporary world cultures. Principles, theories, and ethics of international development projects from a sociocultural perspective.

Anthr 312. Psychological Anthropology. (Dual-listed with 512.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 201 or 306 recommended. Relationship of cultural, social and personality factors in human behavior. Cross-cultural comparisons of child rearing practices, cognitive development, mental health, deviancy, ethno-psychiatry, altered states of consciousness, and psychological dimensions of culture change.

Anthr 313. The Family and Kinship in Cross-Cultural Perspective. (Dual-listed with 513.) (3-0) Cr. 3. S. *Prereq:* 201 recommended. Comparative and historical study of the family and kinship systems in cross-cultural perspective; discussion of the structure, cycle, and functioning of family and kinship systems in ethnography, including the family in Western culture; theoretical issues in contemporary family and kinship studies.

Anthr 314. Southwestern Archaeology. (Dual-listed with 514.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 202 or 308. Prehistory of the American Southwest as reconstructed from archaeological evidence. Includes an introduction to the intellectual frameworks of Southwestern archaeology and surveys the Paleoindian and Archaic cultural periods, the adoption of agriculture, and the emergence of pueblo societies and regional cultures.

Anthr 315. Archaeology of North America. (Dual-listed with 515; same as Am In 315.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 308 or 322 or Am In 210. Prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World; culture-historical sequences of major culture areas; linkages of archaeological traditions with selected ethnohistorically known Native American groups.

Anthr 317. Art, Objects and Culture. (Dual-listed with 517.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* Anthr 201 or 306. Cross-cultural approaches to the material culture of living societies. Importance of cultural objects and artifacts to subsistence, socio-political and economic organization, religion, ideology and aesthetics. Change processes and global impacts on indigenous art traditions, artists, and small-scale craft industries. Participation in interpretation and analysis of departmental ethnographic collections. Basics of material culture collection management. Field trip fee.

Anthr 319. Skeletal Biology. (Dual-listed with 519.) (3-0) Cr. 3. F. *Prereq:* Anthr 202, 307 or college level biology recommended. Comprehensive study of the skeletal anatomy, physiology, genetics, growth, development and population variation of the human skeleton. Applications to forensic anthropology, paleopathology and bioarchaeology are introduced.

Anthr 320. Cultural Continuity and Change in the Prairie-Plains. (Dual-listed with 520; same as Am In 320.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 322 or 415. Ecological adaptations, sociocultural changes, and continuities of traditions among Prairie and Plains Indian groups through time: impacts of Euro-American society and technology on Indians of the Great Plains: perspectives from ecology, archaeology, ethnology, history, and contemporary literary sources.

Anthr 321. World Prehistory. (Dual-listed with 521.) (3-0) Cr. 3. S. *Prereq:* 202 recommended. An introduction to archaeological sites from around the world including the Near East, Africa, Europe, Mesoamerica, and North and South America. Emphasis is on the interpretation of material cultural remains in reconstructing past societies.

Anthr 322. The American Indian. (Dual-listed with 522; same as Am In 322.) (3-0) Cr. 3. F.SS. *Prereq:* 201 or Am In 210 recommended. Origin, distribution, and traditional life of native peoples of North America. Survey of culture areas: ecology and subsistence, language, kinship, life cycle, political, economic, and religious systems; impact of European contact.

Anthr 323. Peoples and Cultures of Latin America. (Dual-listed with 523; same as Am In 323.) (3-0) Cr. 3. S. *Prereq:* 201 or 306 recommended. Origin and distribution of native populations; blending of Old and New World cultures; theoretical problems of

peasant and tribal societies; discussion of economic, social, political, and religious systems; processes of change.

Anthr 325. Peoples and Cultures of Africa. (Dual-listed with 525; same as Af Am 325.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 201 or 306 recommended. Origins and distribution of peoples of Africa; geographical characteristics as related to culture types, including early civilizations; a comparative examination of economic, subsistence, language, social and political organization, and religious systems throughout the continent; change processes, the impact of colonialism, and the nature of contemporary African societies.

Anthr 326. Peoples and Cultures of East and Southeast Asia. (Dual-listed with 526.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 201 or 306 recommended. Origin and development of early civilizations on the western rim of the Pacific, including China, Japan, and mainland and insular Southeast Asia. Survey of current issues in ecological, historical, and ideological contexts.

Anthr 332. American Indians Today. (Dual-listed with 532; same as Am In 332.) (3-0) Cr. 3. S. *Prereq:* 201 or 306; 322 or Am In 210 recommended. Conditions and issues of contemporary Native Americans: historical background of eighteenth and nineteenth century Indian-White relationships; examination of legal status, the reservation system, treaty violations, Indian militancy, education and urbanization, self-determination, social impact of resource development, and other current concerns.

Anthr 333. African American Ethnology. (Dual-listed with 533; same as Af Am 333.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 201 recommended. Ethnographic approaches to the study of African Americans in a cross-cultural and historical perspective: race relations in the Americas.

Anthr 339. Medical Anthropology. (Dual-listed with 539.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 201 or 306. Study of human health in cultural and environmental context; comparison of health and disease patterns of western and non-western populations; healing systems; use of epidemiological models in understanding illness and disease etiologies cross-culturally; interrelationship between diet and culture.

Anthr 340. Magic, Witchcraft, and Religion. (Dual-listed with 540; same as Relig 340.) (3-0) Cr. 3. S. *Prereq:* 201 or 306. Origin and development of indigenous magico-religious systems; myth and ritual; therapeutic aspects; symbols and meanings; religion and sociocultural change, including acculturation, nativistic, and revitalization movements.

Anthr 416. Environmental Archaeology. (Dual-listed with 516.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 308. Examination of relationships between the biophysical environment and socio-cultural organization in the archaeological record. Survey of methods used in environmental sciences by archaeologists to understand the human ecosystem.

Anthr 4271. Archaeology. (Same as Ia LL 4271.) See Iowa Lakeside Laboratory. Nonmajor graduate credit.

Anthr 428. Archaeological Laboratory Methods and Techniques. (Dual-listed with 528.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 308. Laboratory processing and analysis of archaeological materials, experiments in technologies such as stone tools and ceramics, the organization and interpretation of archaeological data. Laboratory sessions emphasize the methods and techniques of analyzing and recording various categories of material culture.

Anthr 429. Archaeological Field School. (Dual-listed with 529.) Cr. 6. SS. 6 weeks. *Prereq:* 308, permission of instructor. Summer field school for training in archaeological reconnaissance and excavation techniques; documentation and interpretation of archaeological evidence. Field trip fee.

Anthr 431. Ethnographic Field School. (Dual-listed with 531.) Cr. 4 or 6. SS. 4 or 6 weeks. *Prereq:* Permission of instructor. Summer field school for training in ethnographic field methods; students will carry out research projects in social anthropology; process will involve learning a variety of investigative

research techniques commonly used in social sciences.

Anthr 450. Survey of Historical and Theoretical Approaches in Anthropology. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* Senior classification, Anthr majors or consent of instructor. Examination of topical and current research directions in the field; assessment and preparation for a career in anthropology; graduate school and employment opportunities discussed.

Anthr 490. Independent Study. Cr. 1 to 5 each time taken. *Prereq:* 9 credits in anthropology. No more than 9 credits of Anthr 490 may be counted toward graduation.

- A. Archaeology
- B. Cultural Anthropology
- C. Biological Anthropology
- D. Linguistic Anthropology (Same as Ling 490D)
- H. Honors

Courses Primarily for Graduate Students, open to qualified undergraduate students

Anthr 500. Language and Culture. (Same as Ling 500.) (3-0) Cr. 3. Alt. S., offered 2001. Approaches to the study of the relationship between language structure, world view, and cognition; social and structural linguistic variation; cross-cultural aspects of verbal and non-verbal communication; linguistic change; contemporary applications of linguistic anthropology.

Anthr 503. Biological Anthropology. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 307. Survey of the history of biological anthropology, current developments and theoretical issues in evolution, human variation and adaptation, population studies, primates and primate behavior, and paleoanthropology.

Anthr 510. Theoretical Dimensions of Cultural Anthropology. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 6 credits in anthropology. Survey of historical and current developments in topical and theoretical approaches to sociocultural anthropology. Examination and assessment of controversies; new research directions and theoretical approaches.

Anthr 511. Culture Change and Applied Anthropology. (Dual-listed with 311.) (3-0) Cr. 3. F. *Prereq:* 6 credits in anthropology, 201 or 306. Theoretical and practical considerations of cultural development. Examination of theories, cultural change, culture contact and acculturation. Dynamics of directed change in contemporary world cultures. Principles, theories, and ethics of international development projects from a sociocultural perspective.

Anthr 512. Psychological Anthropology. (Dual-listed with 312.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 201 or 306 recommended. Relationship of cultural, social and personality factors in human behavior. Cross-cultural comparisons of child rearing practices, cognitive development, mental health, deviancy, ethno-psychiatry, altered states of consciousness, and psychological dimensions of culture change.

Anthr 513. The Family and Kinship in Cross-Cultural Perspective. (Dual-listed with 313.) (3-0) Cr. 3. S. *Prereq:* 6 credits in anthropology, 201 recommended. Comparative and historical study of the family and kinship systems in cross-cultural perspective; discussion of the structure, cycle, and functioning of family and kinship systems in ethnography, including the family in Western culture; theoretical issues in contemporary family and kinship studies.

Anthr 514. Southwestern Archaeology. (Dual-listed with 314.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 202 or 308. Prehistory of the American Southwest as reconstructed from archaeological evidence. Includes an introduction to the intellectual frameworks of Southwestern archaeology and surveys the Paleoindian and Archaic cultural periods, the adoption of agriculture, and the emergence of pueblo societies and regional cultures.

Anthr 515. Archaeology of North America. (Dual-listed with 315.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 308 or 322. Prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World; culture-histori-

cal sequences of major culture areas; linkages of archaeological traditions with selected ethnohistorically known Native American groups.

Anthr 516. Environmental Archaeology. (Dual-listed with 416.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 308. Examination of relationships between the biophysical environment and socio-cultural organization in the archaeological record. Survey of methods used in environmental sciences by archaeologists to understand the human ecosystem.

Anthr 517. Art, Objects and Culture. (Dual-listed with 317.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* Anthr 201 or 306. Cross-cultural approaches to the material culture of living societies. Importance of cultural objects and artifacts to subsistence, socio-political and economic organization, religion, ideology and aesthetics. Change processes and global impacts on indigenous art traditions, artists, and small-scale craft industries. Participation in interpretation and analysis of departmental ethnographic collections. Basics of material culture collection management. Field trip fee.

Anthr 519. Skeletal Biology. (Dual-listed with 319.) (3-0) Cr. 3. F. *Prereq:* Anthr 202, 307 or college level biology recommended. Comprehensive study of the skeletal anatomy, physiology, genetics, growth, development and population variation of the human skeleton. Applications to forensic anthropology, paleopathology, and bioarchaeology are introduced.

Anthr 520. Cultural Continuity and Change in the Prairie-Plains. (Dual-listed with 320.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 322 or 415. Ecological adaptations, sociocultural changes, and continuities of traditions among Prairie and Plains Indian groups through time; impacts of Euro-American society and technology on Indians of the Great Plains; perspectives from ecology, archaeology, ethnology, history, and contemporary literary sources.

Anthr 521. World Prehistory. (Dual-listed with 321.) (3-0) Cr. 3. S. *Prereq:* 202 recommended. An introduction to archaeological sites from around the world including the Near East, Africa, Europe, Mesoamerica, and North and South America. Emphasis is on the interpretation of material cultural remains in reconstructing past societies.

Anthr 522. The American Indian. (Dual-listed with 322.) (3-0) Cr. 3. F. SS. *Prereq:* 201 or Am In 210 recommended. Origin, distribution, and traditional life of native peoples of North America. Survey of culture areas; ecology and subsistence, language, kinship, life cycle; political, economic and religious systems; impact of European contact.

Anthr 523. Peoples and Cultures of Latin America. (Dual-listed with 323.) (3-0) Cr. 3. S. *Prereq:* 6 credits in anthropology, 201 or 306 recommended. Origin and distribution of native populations; blending of Old and New World cultures; theoretical problems of peasant and tribal societies; discussion of economic, social, political, and religious systems; processes of change.

Anthr 525. Peoples and Cultures of Africa. (Dual-listed with 325; same as Af Am 325.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 201 or 306 recommended. Origins and distribution of peoples of Africa; geographical characteristics as related to culture types, including early civilizations; a comparative examination of economic, subsistence, language, social and political organization, and religious systems throughout the continent; change processes, the impact of colonialism, and the nature of contemporary African societies.

Anthr 526. Peoples and Cultures of East and Southeast Asia. (Dual-listed with 326.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 6 credits in anthropology, 201 or 306 recommended. Origin and development of early civilizations on the western rim of the Pacific, including China, Japan, and mainland and insular Southeast Asia. Survey of current issues in ecological, historical, and ideological contexts.

Anthr 528. Archaeological Laboratory Methods and Techniques. (Dual-listed with 428.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 308. Laboratory processing and analysis of archaeological materials, experiments in technologies such as stone tools and

ceramics, the organization and interpretation of archaeological data. Laboratory sessions emphasize the methods and techniques of analyzing and recording various categories of material culture.

Anthr 529. Archaeological Field School. (Dual-listed with 429.) Cr. 6. SS. 6 weeks. *Prereq:* 308, permission of instructor. Summer field school for training in archaeological reconnaissance and excavation techniques; documentation and interpretation of archaeological evidence. Field trip fee.

Anthr 530. Ethnographic Field Methods. Cr. 3. Alt. F., offered 2000. *Prereq:* 6 credits in anthropology, permission of instructor. Field training experience in ethnography. Problems emphasizing field studies in the contemporary societies of the world. Focus on techniques of data gathering and analysis.

Anthr 531. Ethnographic Field School. (Dual-listed with 431.) Cr. 4 or 6. SS. 4 or 6 weeks. *Prereq:* Permission of instructor. Summer field school for training in ethnographic field methods; students will carry out research projects in social anthropology; process will involve learning a variety of investigative research techniques commonly used in social sciences.

Anthr 532. American Indians Today. (Dual-listed with 332.) (3-0) Cr. 3. S. *Prereq:* 6 credits in anthropology, 201 or 306; 322 or Am In 210 recommended. Conditions and issues of contemporary Native Americans; historical background of eighteenth and nineteenth century Indian-White relationships; examination of legal status, the reservation system, treaty violations, Indian militancy, education and urbanization, self-determination, social impact of resource development, and other current concerns.

Anthr 533. African American Ethnography. (Dual-listed with 333.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 6 credits in anthropology, 201 recommended. Ethnographic approaches to the study of African Americans in a cross-cultural and historical perspective; race relations in the Americas.

Anthr 539. Medical Anthropology. (Dual-listed with 339.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 6 credits in anthropology, 201 or 306 recommended. Study of human health in cultural and environmental context; comparison of health and disease patterns of western and non-western populations; healing systems; use of epidemiological models in understanding illness and disease etiologies cross-culturally; interrelationship between diet and culture.

Anthr 540. Magic, Witchcraft, and Religion. (Dual-listed with 340.) (3-0) Cr. 3. S. *Prereq:* 6 credits in anthropology, 201 or 306 recommended. Origin and development of indigenous magico-religious systems; myth and ritual; therapeutic aspects; symbols and meanings; religion and socio-cultural change, including acculturation, nativistic, and revitalization movements.

Anthr 555. Seminar in Archaeology. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 308 or 429, permission of instructor. Examination of the history of anthropological archaeology and current issues and debates concerning methods, theories and the ethics of modern archaeology.

Anthr 590. Special Topics. (Same as Ling 590.) Cr. 1 to 5, *Prereq:* 10 credits in anthropology; senior or graduate classification.

Courses for Graduate Students

Anthr 699. Research.

Architecture

Robert T. Segrest, Chair of Department

Professors: Block, Bloomer, Engelbrecht, Findlay, Heemstra, Mukerjea, Osterberg, Segrest, Shao

Professors (Emeritus): Kainlauri, Kitzman, McKeown, Shank, Stone

Associate Professors: Bassler, Cardinal-Pett,

Chan, Conway, Horwitz, Ingraham, Palermo, Toporek

Associate Professors (Adjunct): Masterson, Rice

Assistant Professors: Bermann, Maves, Muecke, Paxson, Rakatansky, Schwennsen, Singley

Assistant Professors (Adjunct): Fisher, Schulte, Stankard

Undergraduate Study

The undergraduate program in architecture is a five-year curriculum leading to the bachelor of architecture degree. The program provides opportunities for general education as well as preparation for professional practice and/or graduate study. An optional one-semester foreign study program is offered to fourth year students.

The undergraduate curriculum includes one year of preprofessional coursework and four years of professional coursework. Admission to the professional degree program is based on the applicant's performance in the completed preprofessional curriculum; previous high school record (or transfer record where applicable); portfolio and essay evaluations; and on available departmental resources.

Objectives of the Bachelor of Architecture program:

The Department is committed to the study of architecture as a cultural discipline in which issues of practice, of the multiplicity of social formations in which buildings exist, and of environmental effect are enfolded with the subject matter of building design - construction, space, material, form and use. Architecture arises from the aspirations that diverse individuals and groups have for their physical environment, and from the social enterprise of designing and fabricating the landscape we inhabit. It involves individual and multiple buildings, the spaces within them, and the exterior landscape.

It is our intent: that our students develop the skills with which to critically assess and research architectural questions and to invent architectural designs through which those questions are addressed; that they develop a working method for designing and that they have the communication, graphic, modeling and computational skills to support design exploration and to represent their design ideas to others; that they gain knowledge of architectural technologies through which buildings are given form, of which they are constructed and by which they are environmentally tempered; that they understand architectural history, that they understand the theoretical and diverse cultural underpinnings of the discipline of architecture, that they are able to reference architectural precedents and know how to utilize all of these in the development of their ideas; and that they have grounding in the ethical and practical aspects of the architectural profession in society.

For a more complete undergraduate program description, see *College of Design, Curricula*.

Graduate Study

The graduate program in architecture offers opportunities for both professional and post-professional study leading to the master of architecture degree. In each of its three options, the program emphasizes the relationship between professional education and architectural research, culminating in a thesis as a demonstration of both professional competence and a deep understanding of the discipline of architecture.

Objectives of the Graduate Architecture Program:

Graduate students are asked to pursue architecture as a critical practice. Technical, artistic, theoretical, and historical aspects of the discipline are studied in an inventive and interconnected manner, with an emphasis on developing a cogent and comprehensive body of architectural knowledge that is rooted in critical thinking. Students are expected to learn how to bring their knowledge and critical capacity to bear on the construction of buildings; the evaluation of sites, materials and assemblies; the use of technologies; the analysis of cultural issues implicit in architectural work; and the eventual pursuit of normative or experimental professional practices.

The three-and-one-half-year option is designed for individuals with an undergraduate degree other than architecture. Students explore a full range of architectural subjects through seminars, an intensive sequence of design studios, and thesis. One hundred credits are required, including 40 graduate credits.

The two-year option is for individuals with a preprofessional undergraduate major in architecture. Applicants request advanced standing in the three-and-one-half-year option. Following the completion of the requisite professional courses the student is expected to develop an individualized course of study leading to the thesis. Sixty credits are required, including 30 graduate credits.

The one-year option is a post-professional course of study leading to the master of architecture and is designed for individuals with an accredited professional degree in architecture (B.Arch. or M.Arch.). The post-professional option affords the opportunity for advanced study in architectural theory and design leading to the thesis. Thirty credits are required.

The graduate program also offers a course of study leading to the degree master of science in architectural studies. This course of study is designed for students without architecture backgrounds and students with previous degrees in architecture wishing to conduct specialized graduate level research in architecture. Students work closely with faculty who are engaged in high-level research and scholarship. Thirty credits are required.

Double-degree programs are currently offered with the Department of Community and Regional Planning (M.Arch./M.C.R.P.) and the College of Business (M.Arch./M.B.A.).

Financial support in the form of teaching and research assistantships is available.

Contact the department office for specific curricula.

Courses open for nonmajor graduate credit: 420, 421, 422, 423, 424, 425, 426, 427, 434, 437, 451, 471.

Courses Primarily for Undergraduate Students

Arch 102. Pre-Architecture Design. (1-6) Cr. 4. F.S. A studio course focused on three-dimensional design and drawing, with emphasis on creative conceptualization, exploration of materials, and analytical thinking. Includes study of architectural precedents and exercises to develop ability to communicate about form and space.

Arch 182. An Introduction to Architecture. (3-0) Cr. 3. S. *Prereq:* *Open to non-majors.* Through the study of architects, buildings, and theories, this course is designed to introduce the discipline of architecture, presenting architectural process and architectural works as culturally grounded events and artifacts. Field trip fee, materials fee.

Arch 201. Architectural Design I. (1-15) Cr. 6. F. *Prereq:* *Completion of the preprofessional program and admission into the professional program.* An exploration of architectural design through studio projects that focus on the issues of human need, the environment, and the elements of architecture, design conventions, and representational strategies. Primary emphasis on constructive elements. Field trip fee, materials fee.

Arch 202. Architectural Design II. (1-15) Cr. 6. S. *Prereq:* *201.* A continuation of 201 with studio projects that focus on the relationship between the formal and material in terms of the conceptual and experiential dimensions of architecture. Primary emphasis on design process: theories, methodologies, and criticism. Field trip fee, materials fee.

Arch 205. Introduction to Computer Applications in Architecture. (Same as C E 205.) (1-5) Cr. 3. S. *Prereq:* *Credit or enrollment in 201.* Computer applications in architecture with an emphasis on graphics; computer hardware (VAX), software, and terminology; an introduction to the creation, manipulation, analysis and storage of computer model geometry; specification writing using the computer.

Arch 221. History of Western Architecture I. (Same as Dsn S 221.) (3-0) Cr. 3. F.S. Introductory survey with emphasis on the cultural, visual, natural, and constructed context. Ancient through Renaissance. Field trip fee, materials fee.

Arch 222. History of Western Architecture II. (Same as Dsn S 222.) (3-0) Cr. 3. F.S. Introductory survey with emphasis on the cultural, visual, natural, and constructed context. Renaissance to present. Field trip fee, materials fee.

Arch 230. Design Communications I. (0-6) Cr. 2. F. *Prereq:* *Admission to the professional program.* Tools and techniques of freehand drawing. Exercises to develop manual skill and perceptual sensitivity. Investigation of various representational systems and techniques and their applications to the design process, specifically to the coursework in 201. Field trip fee, materials fee.

Arch 232. Design Communications II. (0-6) Cr. 2. S. *Prereq:* *230.* Tools and techniques of freehand drawing. Exercises to develop manual skill and perceptual sensitivity. Advanced study of representational systems and techniques and their applications to the design process, specifically to the coursework in 202. Field trip fee, materials fee.

Arch 240. Materials and Assemblies I. (3-1) Cr. 4. F. *Prereq:* *Completion of the preprofessional program and admission into the professional program.* Introduction to common architectural materials, their physical properties, and integration into light construction subsystems. Model building codes, gravitational and climatic forces, and simplified methods of analysis for the preliminary design of building systems. Field trip fee, materials fee.

Arch 242. Architectural Structures I. (3-1) Cr. 4. S. *Prereq:* *240.* Structural performance and preliminary design of residential scale wood frame members and systems; principles of equilibrium and material behavior. Field trip fee, materials fee.

Arch 271. Human Behavior and Environmental Theory. (3-0) Cr. 3. S. *Prereq:* *Completion of the pre-professional program and admission into the professional program.* Exploration of theories that describe social structure and order and the manner in which individuals and societies organize themselves and structure their environment. Field trip fee, materials fee.

Arch 301. Architectural Design III. (1-15) Cr. 6. F. *Prereq:* *202.* A consideration of landscape as a constructed, cultural artifact. Projects address the perceptual aspects and strategies of situation and location; examination of environmental phenomena and patterns of use and settlement as revealed and affected by the architectural artifact. Development of a critical design process is stressed. Field trip fee, materials fee.

Arch 302. Architectural Design IV. (1-15) Cr. 6. S. *Prereq:* *301.* A continuation of 301, examining housing in the urban situation; diverse scales of use and occupation within the city as shaped by cultural tendencies. Projects examine collective and individual identities related by the condition of adjacency, the ability to consider varieties of scale within a project, and a further development of critical and technical methods. Field trip fee, materials fee.

Arch 332. Two-Dimensional Studio. (0-6) Cr. 2. F.S. Exploration of two-dimensional media. Field trip fee, materials fee.

Arch 334. Computer Applications in Architecture. (2-2) Cr. 3. F.S. *Prereq:* *201, 230 and 232.* Current and potential applications of digital computers in architecture. Projects employing computer-graphic methods. Awareness of programming languages related to applications. Field trip fee, materials fee.

Arch 335. Three-Dimensional Studio. (Same as ArtVS 335.) (0-6) Cr. 2 each time taken, up to a maximum of 8 credits for 335 and 535 combined. F.S. Investigation of basic sculptural media: modeling in clay, wood carving, stone carving, casting in plaster and metal, welding, and other constructing techniques. Field trip fee, materials fee.

Arch 344. Architectural Structures II. (2-1) Cr. 3. F. *Prereq:* *242.* Structural performance and preliminary design of low to medium rise steel frame members and systems, long span steel systems, and masonry walls and systems. Principles of equilibrium and material behavior. Field trip fee, materials fee.

Arch 346. Architectural Structures III. (2-1) Cr. 3. S. *Prereq:* *344.* Structural performance and preliminary design of low to medium rise reinforced concrete and prestressed concrete members and systems. Wind and seismic lateral forces and the principles of equilibrium and material behavior. Field trip fee, materials fee.

Arch 351. Solar Home Design. (Same as Dsn S 351.) (3-0) Cr. 3. S. *Prereq:* *202.* Architectural design and technical analysis of residential structures with emphasis on energy construction and solar energy utilization. Field trip fee, materials fee.

Arch 357. Environmental Forces in Architecture. (3-0) Cr. 3. F. *Prereq:* *Completion of the preprofessional program and admission into the professional program.* Introduction to environmental forces that describe the function of buildings in terms of human comfort and patterns of occupancy. Emphasis on analytical rules of thumb and calculation methods that contribute to design synthesis. A design process is developed utilizing building climatology, control of thermal, luminous, and acoustic environments. Field trip fee, materials fee.

Arch 371. Professional Practice. (3-0) Cr. 3. F. *Prereq:* *202.* Emphasis on the circumstances and opportunities of the professional practice of architecture: practice as profession, process, organization, business, and evolving models of practice. Field trip fee, materials fee.

Arch 372. Design Inquiry. (3-0) Cr. 3. S. *Prereq:* *271.* An overview of methods of inquiry in design. Different ways of thinking about design and design processes in architecture, associating appropriate programming and design activities with project objectives, planning and implementing an effective

process to meet those objectives. Field trip fee, materials fee.

Arch 401. Architectural Design V. (1-15) Cr. 6. F. *Prereq:* 302. Examination of architecture's dialectical relationship with technology and culture; the consideration of the constitution and configuration of public space in its historic and contemporary conditions. Studio projects stress the interpretation and integration of structural, environmental, and communication systems within the architectural construct. Field trip fee, materials fee.

Arch 402. Architectural Design VI. (1-15) Cr. 6. S. *Prereq:* 401. A continuation of 401, closely examining specific urban situations. Advanced studio projects stress the consideration of diverse conditions which create and impact the built environment. Urban design project. Foreign study and urban studio options. Field trip fee, materials fee.

Arch 403. Architectural Design VII. (1-15) Cr. 6. F. *Prereq:* 402. This course provides advanced forums for the demonstration of sophistication in architectural design. Experimentation and innovation are encouraged. Field trip fee, materials fee.

Arch 404. Architectural Design VIII. (1-15) Cr. 6. S. *Prereq:* 403, 485. This comprehensive studio provides a forum for the demonstration of individual competence in architectural design. The work is rigorously examined relative to the entire undergraduate program of study. Field trip fee, materials fee.

Arch 420. History of American Architecture. (Dual-listed with 520.) (3-0) Cr. 3. F. *Prereq:* Junior classification. A survey of the historical development of American architecture. Field trip fee, materials fee. Nonmajor graduate credit.

Arch 421. Topics in Ancient Architecture. (Dual-listed with 521.) (3-0) Cr. 3. S. *Prereq:* Junior classification. The history, theory, and principles of ancient architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Field trip fee, materials fee. Nonmajor graduate credit.

Arch 422. Topics in Medieval Architecture. (Dual-listed with 522.) (3-0) Cr. 3. F. *Prereq:* Junior classification. The history, theory, and principles of medieval architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Field trip fee, materials fee. Nonmajor graduate credit.

Arch 423. Topics in Renaissance to Mid-Eighteenth Century Architecture. (Dual-listed with 523.) (3-0) Cr. 3. S. *Prereq:* Junior classification. The history, theory, and principles of renaissance to mid-eighteenth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Field trip fee, materials fee. Nonmajor graduate credit.

Arch 424. Topics in Nineteenth Century Architecture. (Dual-listed with 524.) (3-0) Cr. 3. F. *Prereq:* Junior classification. The history, theory, and principles of nineteenth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Field trip fee, materials fee. Nonmajor graduate credit.

Arch 425. Topics in Twentieth Century Architecture. (Dual-listed with 525.) (3-0) Cr. 3. F.S. *Prereq:* Junior classification. The history, theory, and principles of twentieth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Field trip fee, materials fee. Nonmajor graduate credit.

Arch 426. History, Theory, and Criticism of Pre-Columbian Mexican Architecture. (Dual-listed with 526.) (3-0) Cr. 3. F. *Prereq:* Junior classification. Study of built environments of pre-conquest Mexico and Central America including the emergence, florescence, and demise of architecture styles, urban and ceremonial centers, religion, social structure and associated arts. Field trip fee, materials fee. Nonmajor graduate credit.

Arch 427. History, Theory, and Criticism of Chinese Architecture. (Dual-listed with 527.) (3-0) Cr. 3. S. *Prereq:* Junior classification. Survey of the history and theoretical concept of Chinese built envi-

ronment with emphasis on the morphology of built form and its relation to art, landscape design, and urban structure. Field trip fee, materials fee. Nonmajor graduate credit.

Arch 431. Experiential Design Presentation. (0-7) Cr. 3. S. *Prereq:* 202, 230. Architectural graphic procedures. Emphasis on perspective design; shades and shadows; fundamentals of tone and line rendering; and environmental contexts. Field trip fee, materials fee.

Arch 434. Computer-aided Architectural and Environmental Design. (1-4) Cr. 3. S. *Prereq:* 334, Com S 107 or 205. Emphasis on application of the computer as a design tool, topical applications and computer graphic methods, development of computer software for architectural and environmental problem solving. Field trip fee, materials fee. Nonmajor graduate credit.

Arch 436. Advanced Design Media. (0-9) Cr. 3 each time taken to a maximum of 6 credits. F.S. *Prereq:* 230, 232. Special topics in design media applications. Field trip fee, materials fee.

Arch 437. Architectural Photography. (3-0) Cr. 3. F. *Prereq:* 202. Emphasis on use of the camera and lighting in photographing drawings and interior and exterior building environments. Field trip fee, materials fee. Nonmajor graduate credit.

Arch 448. Materials and Assemblies II. (3-0) Cr. 3. F. *Prereq:* 346. Investigation of the materials and integrated systems found in complex construction assemblies. Emphasis on determination and utilization of appropriate forms of material assemblies and structural systems for large scale construction. Field trip fee, materials fee.

Arch 451. Alternative Energy Systems in Architecture. (Dual-listed with 551.) (3-0) Cr. 3. F. *Prereq:* 357 or graduate standing. Alternative energy sources and systems for architecture. Field trip fee, materials fee. Nonmajor graduate credit.

Arch 458. Environmental Control Systems. (3-0) Cr. 3. F. *Prereq:* 357. Overview of architectural environmental control systems in response to occupant comfort, patterns of use, health, and safety regulations. Emphasis on the analytical rules of thumb and calculation methods necessary to provide integrated design synthesis of technical systems within architecture. A process is developed to aid in understanding the use and design of mechanical, electrical, plumbing, fire safety, transportation, and conveying systems and subsystems. Field trip fee, materials fee.

Arch 467. Preservation, Restoration, and Rehabilitation. (Same as Dsn S 467.) (3-0) Cr. 3. S. *Prereq:* Senior classification. Construction standards and procedures for preserving, restoring, reconstructing, and rehabilitating existing buildings following the guidelines of the National Park Service and the National Trust for Historic Preservation. Field trip fee, materials fee.

Arch 471. Design for All People. (Same as Dsn S 471, Geron 471, Hous 471.) (3-0) Cr. 3. S. *Prereq:* Senior classification or graduate standing. Principles and procedures of universal design in response to the varying ability level of users. Assessment and analysis of existing buildings and sites with respect to standards and details of accessibility for all people, including visually impaired, mentally impaired, and mobility restricted users. Design is neither a prerequisite nor a required part of the course. Enrollment open to students majoring in related disciplines. Field trip fee. Nonmajor graduate credit.

Arch 485. Contemporary Architectural Issues. (2-0) Cr. 2. F. *Prereq:* Credit or enrollment in Arch 403. Topical lectures, readings and seminar presentations regarding contemporary architectural issues in support of Arch 404. Field trip fee, materials fee.

Arch 486. Changing States: Identity and Difference. (3-0) Cr. 3. S. The distinctive identities of gender, race, ethnicity, class, sexuality, and nationality are the identities which have, for so long, constructed the modern world. These are now in decline, giving rise to fragmented and complex forms of identification. How does this crisis of identity relate to the wider processes of change which prob-

lematise modern societies and undermine the frameworks throughout which people relate to institutions, each other and themselves. Why is identity such a compelling and problematic issue: What are the forces at play in constructing (and dismantling) identity.

Arch 490. Independent Study. F.S.SS. Cr. 1 to 9. *Prereq:* Written approval of instructor and department chair on required form. Independent investigation.

- A. Design Communications. Materials fee.
- B. Design
- C. Technical Systems. Field trip fee.
- D. Architectural History
- E. Behavioral Studies
- F. Practice
- H. Honors

Courses Primarily for Graduate Students, open to qualified undergraduate students

Arch 501. Architectural Design and Communication I. (1-15) Cr. 6. F. *Prereq:* Admission to the M.Arch. program. Emphasis on design process; the elements, concepts, and precedents of architectural design and graphic communications. Field trip fee, materials fee.

Arch 502. Architectural Design and Communication II. (1-15) Cr. 6. S. *Prereq:* 501. Emphasis on the contextual parameters of architectural design and their graphic representation. Field trip fee, materials fee.

Arch 503. Architectural Design and Communication III. (1-15) Cr. 6. SS. *Prereq:* 502. Emphasis on architectural systems and design presentation graphics. Field trip fee, materials fee.

Arch 520. History of American Architecture. (Dual-listed with 420.) (3-0) Cr. 3. F. *Prereq:* Graduate classification. A survey of the historical development of American architecture. Field trip fee, materials fee.

Arch 521. Topics in Ancient Architecture. (Dual-listed with 421.) (3-0) Cr. 3. S. *Prereq:* 221, 222 and senior classification or graduate standing. The history, theory, and principles of ancient architecture and urban design considering relationship to the culture, visual arts, site, and surroundings. Field trip fee, materials fee.

Arch 522. Topics in Medieval Architecture. (Dual-listed with 422.) (3-0) Cr. 3. F. *Prereq:* 221, 222 and senior classification or graduate standing. The history, theory, and principles of medieval architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Field trip fee, materials fee.

Arch 523. Topics in Renaissance to Mid-eighteenth Century Architecture. (Dual-listed with 423.) (3-0) Cr. 3. S. *Prereq:* 221, 222 and senior classification or graduate standing. The history, theory, and principles of renaissance to mid-eighteenth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Field trip fee, materials fee.

Arch 524. Topics in Nineteenth Century Architecture. (Dual-listed with 424.) (3-0) Cr. 3. F. *Prereq:* 221, 222 and senior classification or graduate standing, permission of instructor. The history, theory, and principles of nineteenth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Field trip fee, materials fee.

Arch 525. Topics in Twentieth Century Architecture. (Dual-listed with 425.) (3-0) Cr. 3. F.S. *Prereq:* 221, 222 and senior classification or graduate standing. The history, theory, and principles of twentieth century architecture and urban design considering relationships to the culture, visual arts, site, and surroundings. Field trip fee, materials fee.

Arch 526. History, Theory, and Criticism of Pre-Columbian Mexican Architecture. (Dual-listed with 426.) (3-0) Cr. 3. F. *Prereq:* Senior classification or graduate standing. Built environments of pre-conquest Mexico and Central America including the emergence, florescence, and demise of architectural styles, urban and ceremonial centers, religion, social

structure, and associated arts. Field trip fee, materials fee.

Arch 527. History, Theory, and Criticism of Chinese Architecture. (Dual-listed with 427.) (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* The history and theoretical concept of Chinese built environment with emphasis on the morphology of built form and its relationship to art, landscape design, and urban structure. Field trip fee, materials fee.

Arch 528. Topical Studies in History, Theory, and Criticism of Architecture. (Same as Dsn S 528.) (2-0 or 3-0) Cr. 2 or 3 each time taken. F.S. *Prereq: 221, 222 or senior classification or graduate standing.* Field trip fee, materials fee.

- A. Pre-Modern
- B. Modern
- C. American
- D. World Architecture
- E. Architects
- F. Historic Preservation
- G. Technical, Structural, and Programmatic
- I. Urban Design
- J. Vernacular Architecture
- K. Practice

Arch 532. Advanced Two-Dimensional Studio. (0-6) Cr. 2. F.S. *Prereq: 332 or graduate standing.* Advanced exploration of two-dimensional media. Field trip fee, materials fee.

Arch 534. Advanced Computer-aided Architectural Design. (1-4) Cr. 3 each time taken, maximum of 6 credits. F.S. *Prereq: 434, permission of instructor.* Emphasis on concepts, algorithms, data structures and data base development, evaluation and development of software for complex data management, and applications in architectural design. Field trip fee, materials fee.

Arch 535. Advanced Three-Dimensional Studio. (0-6) Cr. 2 each time taken, up to a maximum of 8 credits for 335 and 535 combined. F.S. *Prereq: 335 or graduate standing.* Advanced investigation of sculptural expression with emphasis on individual projects. Field trip fee, materials fee.

Arch 540. Materials and Assemblies I. (3-2). Cr. 4. F. *Prereq: Graduate standing.* Study of the science and technology of building materials, emphasizing the particular properties of basic materials, processes for their configuration into building elements, their performance and their application to building design. Field trip fee, materials fee.

Arch 545. Construction Methods. (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* Advanced studies of construction methods and procedures. Field trip fee, materials fee.

Arch 551. Alternative Energy Systems in Architecture. (Dual-listed with 451.) (3-0) Cr. 3. F. *Prereq: 357 or graduate standing.* Alternative energy sources and systems for architecture. Field trip fee, materials fee.

Arch 552. Architectural Luminous Environment. (3-0). Cr. 3. S. *Prereq: Senior classification or graduate standing.* An integrated study of the concepts of lighting: natural and artificial lighting, visual stimuli, comfort, discomfort, perception, and active and passive systems of control. Emphasis on daylighting design. Field trip fee, materials fee.

Arch 553. Architectural Thermal Environment. (3-0). Cr. 3. S. *Prereq: 401 or graduate standing, and 458.* An integrated study of the concepts of thermal stimuli, comfort, active and passive systems of control. Field trip fee, materials fee.

Arch 554. Architectural Acoustic Environment. (3-0). Cr. 3. F. *Prereq: Senior classification or graduate standing.* An integrated study of the concepts of acoustic stimuli, noise control, room acoustics, and sound isolation. Field trip fee, materials fee.

Arch 557. Advanced Studies in Building Systems. (3-0) Cr. 3. F. *Prereq: Graduate standing.* Advanced studies of the integration and development of technical building systems. Field trip fee, materials fee.

Arch 558. Appropriate Technologies for Architecture. (Same as Dsn S 558.) (3-0) Cr. 3. S.

Prereq: Graduate standing. Appropriate uses of technology in building design. Field trip fee, materials fee.

Arch 562. Housing Design Issues. (Same as Hous 562, Dsn S 562.) (3-0) Cr. 3. F.S. Social, economic, and environmental factors related to the planning and design of single family and multi-family housing. Open to students in related disciplines. Field trip fee.

Arch 566. Housing for Specific Groups. (Same as Geron 566, Hous 566, Dsn S 566.) (3-0) Cr. 3. S. *Prereq: Senior classification or graduate standing.* Principles of gerontology as related to planning, programming, designing, and evaluating housing environments for elderly residents. The continuum of age segregated and age integrated housing options for older people including independent living, congregate living, shared living, continuing care retirement communities, and nursing care environments. Design is neither a prerequisite nor a required part of the course. Open to students in related disciplines with an interest in gerontology and/or housing. Field trip fee, materials fee.

Arch 572. Architectural Programming. (3-0) Cr. 3. S. *Prereq: 372 or graduate standing.* Determination of space, site, and cost factors for design. Emphasis on methods, techniques, and applications. Field trip fee, materials fee.

Arch 573. Post-Occupancy Evaluation. (Same as Dsn S 573.) (3-0) Cr. 3. F. *Prereq: Senior classification or graduate standing.* Methods of evaluating the physical, social, and psychological performance of buildings following construction and occupancy, with emphasis on behavioral response to the environment and its role in the design process. Field trip fee, materials fee.

Arch 575. Contemporary Urban Design Theory. (Same as Dsn S 575.) (3-0) Cr. 3. F.S. *Prereq: Senior classification or graduate standing.* Current urban design theory and its application to urban problems. Field trip fee, materials fee.

Arch 577. Social Impact of the Built Environment. (Same as Dsn S 577.) (3-0) Cr. 3. S. *Prereq: Graduate standing.* Interdisciplinary review and analysis of social scientific research applied to architectural design. Field trip fee, materials fee.

Arch 582. Professional Practice Seminar. (1-0 to 3-0) Cr. 1 to 3 each time taken, up to a maximum 6 cr. F.S. *Prereq: 371 or graduate standing.* Investigation of the changing relationships between professional practice and the needs of society. Field trip fee, materials fee.

Arch 585. Theory I: Contemporary Theories. (3-0) Cr. 3. F. *Prereq: Graduate standing.* A select study of contemporary architectural texts. Readings will explore the nature of the text, its relationship to architectural practice, and the social, political and intellectual context of its production. Field trip fee, materials fee.

Arch 587. Theory II: Theories and History. (3-0) Cr. 3. F. *Prereq: Graduate standing or 401.* The relevance of the theoretical device is discussed through the reading of architectural treatises. Interpretations of language, form, and meaning will seek to explore relationships to the production of contemporary architecture. Field trip fee, materials fee.

Arch 589. Theory III: Methods of Inquiry. (3-0) Cr. 3. F. *Prereq: 401, or graduate standing.* Seminar course examining the nature of architectural research, the development of the research topic and methods of inquiry. Research approaches include comparative case studies and evaluative and critical approaches in history; theory and criticism as related to architectural scholarship. Field trip fee, materials fee.

Arch 590. Special Topics. Cr. 1 to 5 each time taken. F.S.SS. *Prereq: Written approval of instructor and department chair on approved form.* Investigation of architectural issues having a specialized nature. Field trip fee, materials fee.

Courses for Graduate Students

Arch 601. Advanced Architectural Design I. (1-15) Cr. 6. F. *Prereq: Admission into the graduate program.* Complex architectural design problems incorporating aesthetic, technological, social, and contextual issues. Field trip fee, materials fee.

Arch 602. Advanced Architectural Design II. (1-15) Cr. 6. S. *Prereq: 601.* Complex architectural design problems incorporating aesthetic, technological, social, and contextual issues. Field trip fee, materials fee.

Arch 603. Advanced Architectural Design III. (1-15) Cr. 6 each time taken up to a maximum of 12 credits. F.S. *Prereq: Professional degree in architecture or advanced standing in the graduate program.* Architectural and urban design problems. Field trip fee, materials fee.

Arch 690. Independent Design Study. (1-15) Cr. 6. F.S. *Prereq: Admission to MSAS or MARCH 30 credit program.* Independent architectural design projects commensurate with student interests requiring approval of Architecture Graduate Advisory Committee. Field trip fee, materials fee.

Arch 699. Thesis. (1-18) Cr. 3-9. F.S.SS.

Art and Design

Mary Stieglitz, Chair of Department

Professors: Bro, Dake, Evans, Fowles, Singer, Smith, Stieglitz, Weinkein

Distinguished Professors (Emeritus): Heggen, Miller

Professors (Emeritus): Allen, Danielson, Held, Petersen, Pickett, Sontag

Associate Professors: Akkurt, Baer, Croyle, Cunnally, Fontaine, Friedman, Gibbs, Herrnstadt, Jones, Lehner, Lorr, Malven, McIlrath, Mickelson, Polster, Sage, Stout, Tartakov, Warme, Weber

Associate Professors (Adjunct): Pohlman

Associate Professors (Emeritus): McClain, Sreenivasam

Assistant Professors: Beecher, Caldwell, Curran, Gruber, Iasevoli, Lilligren, Mikovec, Richards, Tilden

Assistant Professors (Adjunct): Walton

Instructors (Adjunct): Biechler

Undergraduate Study

The department offers work for the degrees bachelor of fine arts and bachelor of arts. Programs in general studio art and/or art history, craft design, drawing/painting/printmaking, graphic design, interior design, and visual studies are possible within four curricula: art and design—B.F.A., art and design—B.A., graphic design, and interior design—B.F.A.; see *College of Design, Curricula*. Each of these curricula affords excellent preparation for a variety of career opportunities or a basis for graduate study in art and design disciplines.

The curriculum in art and design leading to the B.F.A. provides a studio concentration. Students select an emphasis in one of the following areas: (1) craft design (ceramics, fiber, jewelry and metal, wood), (2) drawing/painting/printmaking, (3) visual studies (calligraphy, computer-aided art and design, illustration, photography, two- and three-dimensional mixed media). The three concentrations emphasize aesthetics, visual problem solving and skill development in a variety of media employing contemporary, historical and cultural thought with visual languages.

The curriculum in graphic design leads to the B.F.A. degree. Emphasis is on creative problem solving, the design process, and the visual organization of communication media. Graphic design graduates effectively integrate abstract thinking skills; communication design theory, history, and methodology; technology; design process; and communication design systems including typography, symbology, and image creation with an understanding of professional practice.

The curriculum in interior design leads to the B.F.A. degree. Emphasis is on the student's application of the design process to creatively solve problems of the interior environment based on a knowledge of techniques, materials, resources, human factors, and interrelated professional responsibility. Graduates in interior design are competent in visual communication (sketching, drafting and computer aided design), design problem solving, space planning, lighting for interiors, finish and furniture selection, and detailing interior construction.

Students working toward the B.A. in art and design pursue studies in a related or supporting area by means of a second major, minor, and/or approved program of study that meets the individual needs of a student. Art history, art education, craft design, drawing/painting/printmaking, visual studies, pre-graphic design, and pre-interior design courses may be taken to fulfill the art and design program of study.

Students planning a career in art education, preparing for certification to teach art in grades kindergarten through twelve, should matriculate in the art and design curriculum leading to the B.F.A. degree. This sequencing will provide a strong studio background. Many requirements for teacher certification are course options within general education requirements. Students should work closely with a department adviser in planning their program of study to maximize their ability to meet entrance requirements to the teacher education program. For general requirements for teacher certification, see *College of Education*.

Transfer students with studio credits from other colleges and universities must present, for department review, a portfolio of work done in those courses in order to have the credits apply toward specific studio requirements. Students are advised to present this portfolio of work upon admission and prior to registration for classes.

A fee will be assessed when field trips are indicated. In many courses, fees for materials are required.

The department offers no minor but participates in the undergraduate minor in design studies.

Graduate Study

The department offers work for the degrees master of arts in art and design and master of fine arts in graphic design and interior design and minor work for students with majors in other departments. Degree specializations leading to the master of arts degree are available in art education, craft design, intermedia,

drawing/painting/printmaking, and interior design. Within the general area of craft design the following emphases are available: ceramics, fiber, jewelry and metal, and wood design. Graduates have a broad understanding of visual communication, problem solving, and interdisciplinary studies. Graduates in interior design selecting the M.A. degree focus on research.

Graduate students who have not completed an undergraduate program of study substantially equivalent to that required of undergraduates in the department can expect that additional supporting coursework, determined by the graduate faculty, will be required.

The master of arts program requires a minimum of 30 credits including an art and design seminar, a studio concentration, a history/criticism course, elective courses outside the department, and completion of a thesis or thesis-exhibition.

Students in the master of arts studio programs select an original area of investigation for the thesis or thesis-exhibition. For further information, see *Graduate College, Master of Science and Master of Arts*. The thesis-exhibition is based on the development of a body of original artwork which is presented in a culminating exhibition. A written paper is required as part of the thesis-exhibition. The program of study committee determines whether a thesis or thesis-exhibition option is appropriate.

Graduate students in the art education specialization leading to the M.A. degree participate in a 30 credit program of study which is linked with the New Art Basics research project. If they do not hold teacher certification, students may work toward acquiring this as part of their graduate study. A creative component is required for the master of arts degree and is fulfilled through individually focused discipline-specific classroom research, culminating in a written summary of research results. Graduates with a specialization in art education are competent as reflective teachers, experienced in applied, qualitative research in the K-12 classroom. Graduates gain a deep understanding of the New Art Basics approach to visual thinking skills and global, multicultural, visual arts education, with a learner-centered focus.

The master of fine arts program requires a minimum of 60 credits including an art and design seminar, a studio concentration, history and criticism courses, a teaching practicum, elective courses outside the department or area of study, and the completion of a thesis-exhibition or thesis. The master of fine arts degree is offered only in graphic design and interior design.

The M.F.A. thesis-exhibition is composed of two parts, a substantial exhibition and a written statement that describes the development of the work in the exhibition, its objectives, and its historical and cultural points of reference. A thesis may be an appropriate alternative, but some portion of the work should entail an element of design problem-solving in the form of a visual product.

Master of Fine Arts graduates in graphic design are skilled in communication design, problem solving, and are adept in the use of visual language and symbology. Graduates are proficient in the design of communications and the use of technologies that incorporate human interaction with environments, objects, electronic and traditional publications.

Interior Design graduate students selecting the M.F.A. are proficient in visual communication skills, design theory, and space planning. The M.F.A. degree is considered a terminal degree in the interior design field.

Credit earned at Iowa State University or other institution for the master of arts degree may be applied toward the master of fine arts degree at the discretion of the program of study committee.

Applicants to the graduate program should have an undergraduate major in an art or design area and demonstrate the ability to do technically competent and original work through the presentation of a slide portfolio for faculty review. Past academic performance and the quality of studio work are critical in the admission process. A minimum 3.0 GPA in the student's undergraduate major is the standard for full admission to the graduate program. Admission is also determined by studio space available within the program area, which changes yearly due to graduate students' progress in their programs of study.

Prospective students are advised to contact the graduate coordinator with specific questions about admission procedures and portfolio review. Application and additional program information may be obtained from the Department of Art and Design, College of Design, Iowa State University, Ames, Iowa 50011-3092.

The department participates in the interdepartmental minor in housing (see *Index*).

Courses open for nonmajor graduate credit:
ArtCD 420, 422, 427, 447, ArtDP 430, 438, ArtGr 387, 388, ArtID 355, 356, 464, 465, 467, Art H 380, 381, 382, 383, 385, 386, 387, 389, 391, 394, 395, 396, ArtVS 302, 303, 304, 408.

Art (Art)

Courses Primarily for Undergraduate Students

Art 108. Visual Foundations I. (0-6) Cr. 3. F.S.S. Exploring visual order, creative process, and interaction of two- and three-dimensional design. Introduction to color. Materials fee.

Art 109. Visual Foundations II. (0-6) Cr. 3. F.S. *Prereq:* 108. Continued exploration of visual order, creative process, and interaction of two- and three-dimensional design and color. Materials fee.

Art 110. Orientation to Art and Design. (1-0) Cr. R. F.S. Overview of the department and university with special emphasis on curricula, program planning, and study skills. Advising, policy and procedures, student services. Offered on a satisfactory-fail grading basis only.

Art 130. Drawing I. (1-6) Cr. 3. F.S.S.S. Drawing concepts with practical application; various media, materials, and subject matter. Materials fee.

Art 230. Drawing II. (0-6) Cr. 3. F.S. *Prereq:* 130. Composition and techniques in relation to visual imagery. Materials fee.

Art 292. Dimensions of Art and Design. (Same as Dsn S 292.) (3-0) Cr. 3. F.S. The work of the artist

and designer through an examination of the design process, artistic style, and selected art and design forms. Cross-cultural viewpoints and issues of diversity in relation to the visual arts and design fields. Primarily for nonmajors. Materials fee.

Art 494. Art and Design in Europe Seminar. (1-0) Cr. 1. S. *Prereq: Permission of instructor and planned enrollment in 495.* Cultural and historical aspects of art and design in Western Europe in preparation for study abroad. Area of study varies each time offered. Materials fee. Offered on a satisfactory-fail grading basis only.

- A. Fine Arts
- G. Graphic Design
- I. Interior Design
- N. Art History

Art 495. Art and Design in Europe. (Dual-listed with 595.) Arr. Cr. 3. F.S.S. *Prereq: 494, permission of instructor.* International study abroad program in western Europe. Visits to design studios, art museums, and educational facilities. Related activities depending on specific area of study which may vary each time offered. Tour expenses to be paid by the student.

- A. Fine Arts
- G. Graphic Design
- I. Interior Design
- N. Art History

Art 496. Art and Design Field Study. Arr. Cr. R. *Prereq: Enrollment in an art and design studio or art history course, permission of instructor.* Study and tours of museums, galleries, artist and/or designer studios and other areas of interest within art and design. Offered on a satisfactory-fail basis. May be repeated. Field trip fee, materials fee.

Art 497. Studio Internship. Arr. Cr. 1 to 6 each time taken, maximum of 6. F.S.S.S. *Prereq: Advanced classification in a department curriculum. Written approval of supervising instructor and department chair on required form in advance of semester of enrollment.* Supervised experience with a cooperating artist or studio. Offered on a satisfactory-fail grading basis only.

Art 498. Museum/Gallery Internship. Arr. Cr. 1 to 6 each time taken, maximum of 6. F.S.S.S. *Prereq: Advanced classification in a department curriculum. Written approval of supervising instructor on required form in advance of semester of enrollment.* Supervised experience with a cooperating museum or gallery or art center. Offered on a satisfactory-fail grading basis only.

Art 499. BFA Seminar and Exhibition. Arr. Cr. 1. S. *Prereq: Senior classification in the Art and Design-BFA curriculum.* Participation in a group exhibition. Statement of artistic philosophy and career goals; resume development. Students should enroll in this course the spring semester prior to completion of the BFA degree. Offered on a satisfactory-fail basis only.

Courses Primarily for Graduate Students, open to qualified undergraduate students

Art 501. Art and Design Seminar. (3-0) Cr. 3. F. *Prereq: Permission of instructor.* Presentation and discussion of basic issues in contemporary art and design. Materials fee.

Art 511. Seminar in Teaching. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: Graduate classification.* Readings and discussion of university level design education issues; studio/classroom observation; development of a teaching philosophy; lesson planning and presentation. Materials fee.

Art 595. Art and Design in Europe. (Dual-listed with 495.) Arr. Cr. 3. F. *Prereq: Graduate classification, 494 or equivalent, permission of instructor.*

International study abroad program in western Europe. Visits to design studios, art museums, and educational facilities. Related activities depending on specific area of study which may vary each time offered. Tour expenses to be paid by the student.

- A. Fine Arts
- G. Graphic Design
- I. Interior Design
- N. Art History

Art 598. Museum/Gallery Internship. Arr. Cr. 1 to 6 each time taken, maximum of 6. F.S.S.S. *Prereq: Graduate classification and permission of instructor. Written approval in advance of semester of enrollment.* Supervised experience with a cooperating museum or gallery or art center. Offered on a satisfactory-fail grading basis only.

Courses for Graduate Students

Art 697. Studio Internship. Arr. Cr. var., maximum of 9. F.S.S.S. *Prereq: Graduate classification and approval of department chair.* Supervised off-campus learning experience with a prominent artist, designer, or firm.

Art 698. Current Issues in Art and Design. Cr. 1 to 3, each time taken, maximum of 9. *Prereq: Graduate classification.* Selected issues in contemporary art and design literature and work. Topics and readings vary each time offered. Materials fee.

- G. Graphic Design
- I. Interior Design
- K. Interdisciplinary Design

Art 699. Research. Cr. var.

- A. Thesis
- B. Thesis-exhibition (Materials fee)

Craft Design (ArtCD)

Courses Primarily for Undergraduate Students

ArtCD 220. Wood Design I. (0-6) Cr. 3. F.S. Wood as a design medium. Design and creation of wooden forms, visual communication and hand processes. Materials fee.

ArtCD 222. Ceramics I. (0-6) Cr. 3. F.S. Visual problem solving through ceramic processes and concepts. Techniques introduced: handbuilding, wheel throwing, glazing and firing. Materials fee.

ArtCD 227. Jewelry and Decorative Metalsmithing I. (0-6) Cr. 3. F.S. Design of jewelry and metal objects using basic construction techniques. Materials fee.

ArtCD 320. Wood Design II. (0-6) Cr. 3 each time taken, maximum of 6. F.S. *Prereq: 220.* Design and fabrication of furniture forms, visual communication, advanced shaping, and joining processes. Materials fee.

ArtCD 322. Ceramics II. (0-6) Cr. 3 F.S. *Prereq: 222.* Problems using ceramic concepts and glaze calculation. Materials fee.

ArtCD 325. Craft Design Seminar. (2-0) Cr. 2. Alt. F., offered 1999. *Prereq: 3 credits in craft design.* Contemporary issues in craft design through lectures, presentations, and field trips. Field trip fee, materials fee.

ArtCD 327. Jewelry and Decorative Metalsmithing II. (0-6) Cr. 3. F.S. *Prereq: 227.* Design of jewelry and hollow forms combining traditional and contemporary methods. Materials fee.

ArtCD 343. Fiber Forms. (0-6) Cr. 3. F.S. Three-dimensional contemporary fiber construction. Visual problem-solving and conceptual idea development using processes and techniques such as knotting, wrapping, plaiting, netting, feltmaking, sculptural fabric manipulation, and basketry. Materials fee.

ArtCD 344. Weaving. (0-6) Cr. 3. F.S. Color and pattern development through interlocking yarns. Floor loom and frame loom fabric construction. Materials fee.

ArtCD 345. Fiber and Fabric Design. (0-6) Cr. 3. Shaped, patterned, manipulated, and embellished textiles using contemporary and traditional yarn, thread, and cloth techniques. Materials fee.

ArtCD 346. Resist and Dyed Fabric Design. (0-6) Cr. 3. F. Two- and three-dimensional problems in visual imagery using dye and resist processes. Materials fee.

ArtCD 347. Printed Fabric Design. (0-6) Cr. 3. F.S. Repeat pattern and overlapping transparent colors for fabric design using screenprinting and direct application of pigments. Materials fee.

ArtCD 420. Wood Design III. (Dual-listed with 520.) (0-6) Cr. 3 each time taken, maximum of 12. F.S.

Prereq: 320. Independent design and creation of furniture forms. Research and development of furniture forms utilizing innovative processes. Materials fee. Nonmajor graduate credit.

ArtCD 422. Ceramics III. (Dual-listed with 522.) (0-6) Cr. 3 each time taken, maximum of 12. F.S. *Prereq: 322.* Forms and surfaces; historical research. Personal directions in advanced ceramic processes and concepts. Materials fee. Nonmajor graduate credit.

ArtCD 427. Jewelry and Decorative Metalsmithing III. (Dual-listed with 527.) (0-6) Cr. 3 each time taken, maximum of 12. F.S. *Prereq: 327.* Design of jewelry and hollow forms using construction techniques. Materials fee. Nonmajor graduate credit.

ArtCD 447. Fiber/Fabric Studio Problems. (Dual-listed with 547.) (0-6) Cr. 3 each time taken, maximum of 9. S. *Prereq: 6 credits from among 343, 344, 345, 346, 347.* Exploration of imagery using woven and surface design processes. Personal development and exploration of ideas. Field trip fee, materials fee. Nonmajor graduate credit.

ArtCD 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment.* Student must have completed craft design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

- C. Ceramics (materials fee)
- F. Fiber (materials fee)
- H. Honors (materials fee)
- M. Metals (materials fee)
- W. Wood Design (materials fee)

ArtCD 493. Workshop. Cr. 1 to 3 each time taken. SS. *Prereq: Permission of instructor.* Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisites.

- C. Ceramics (materials fee)
- F. Fiber (materials fee)
- M. Metals (materials fee)
- W. Wood Design (materials fee)

Courses Primarily for Graduate Students, open to qualified undergraduate students

ArtCD 520. Wood Design Studio. (Dual-listed with 420.) (0-6) Cr. 3 each time taken, maximum of 12. F.S. *Prereq: Graduate classification, permission of instructor.* Independent design and creation of furniture forms. Research and development of furniture forms utilizing advanced and/or innovative processes. Materials fee.

ArtCD 522. Ceramics Studio. (Dual-listed with 422.) (0-6) Cr. 3 each time taken, maximum of 12. F.S. *Prereq: Graduate classification, permission of instructor.* Forms and surfaces; historical research. Personal directions in ceramic processes and concepts. Materials fee.

ArtCD 527. Jewelry and Decorative Metalsmithing Studio. (Dual-listed with 427.) (0-6) Cr. 3 each time taken, maximum of 12. F.S. *Prereq: Graduate classification, permission of instructor.* Design of jewelry and hollow forms using advanced construction techniques. Materials fee.

ArtCD 547. Fiber/Fabric Studio Problems. (Dual-listed with 447.) (0-6) Cr. 3 each time taken, maximum of 9. S. *Prereq: Graduate classification, permission of instructor.* Exploration of imagery using woven and surface design processes. Personal development and exploration of ideas. Field trip fee, materials fee.

ArtCD 590. Special Topics. Cr. arr. *Prereq: Bachelor's degree in art and/or design, or evidence of satisfactory equivalency in specialized area. Written approval of instructor and department chair on required form in advance of semester of enrollment.*

- C. Ceramics (materials fee)
- F. Fiber (materials fee)
- M. Metals (materials fee)
- W. Wood Design (materials fee)

ArtCD 593. Workshop. Cr. 1 to 3 each time taken. SS. *Prereq: Graduate classification, permission of*

instructor. Intensive 2 to 4 week studio exploration. Topics vary each time offered and may have prerequisite sites.

- C. Ceramics (materials fee)
- F. Fiber (materials fee)
- M. Metalsmithing (materials fee)
- W. Wood Design (materials fee)

Drawing/Painting/Printmaking (ArtDP) **Courses Primarily for Undergraduate Students**

ArtDP 233. Watercolor Painting. (0-6) Cr. 3. F.S. *Prereq:* Art 230. Painting using waterbased media. Materials fee.

ArtDP 238. Painting I. (0-6) Cr. 3. F.S. *Prereq:* Art 230. Painting using acrylic and/or oil media. Materials fee.

ArtDP 330. Drawing III: Life Drawing. (0-6) Cr. 3 each time taken, maximum of 9. F.S. *Prereq:* Art 230. Drawing from the human figure. Materials fee.

ArtDP 338. Painting II. (0-6) Cr. 3. F.S. *Prereq:* 238. Painting using acrylic and/or oil media; composition and expression. Materials fee.

ArtDP 356. Relief Printmaking. (Dual-listed with 556.) (0-6) Cr. 3 each time taken, maximum of 6. F. *Prereq:* Art 230. Woodcut and linoleum cut printmaking processes in black and white, multiblock color, and reduction color printing. Collographs and forms of relief printmaking used separately and in combination with woodcuts. Materials fee.

ArtDP 357. Monotype. (Dual-listed with 557.) (0-6) Cr. 3 each time taken, maximum of 6. S. *Prereq:* 238. Monoprint and monotype processes; black and white and color techniques. Basic knowledge, production procedures, and drawing skills; experimentation. Materials fee.

ArtDP 358. Lithography. (Dual-listed with 558.) (0-6) Cr. 3 each time taken, maximum of 6. F.S. *Prereq:* Art 230. Planographic printmaking process: theory and practice. Studio procedures, drawing, and printing skills applied to metal plate lithography. Materials fee.

ArtDP 359. Intaglio. (Dual-listed with 559.) (0-6) Cr. 3 each time taken, maximum of 9. F.S. *Prereq:* Art 230. Intaglio printmaking processes. Basic knowledge and production procedures, drawing, and printing skills. Materials fee.

ArtDP 430. Drawing IV. (Dual-listed with 530.) (0-6) Cr. 3 each time taken, maximum of 9. F.S. *Prereq:* Art 330. Figurative and/or non-figurative drawing with advanced work in media, composition, and theory. Materials fee. Nonmajor graduate credit.

ArtDP 438. Painting III. (Dual-listed with 538.) (0-6) Cr. 3 each time taken, maximum of 9. F.S. *Prereq:* 338. Figurative and/or non-figurative painting with advanced work in media, composition, and theory. Materials fee. Nonmajor graduate credit.

ArtDP 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* *Written approval of instructor and department chair on required form in advance of semester of enrollment.* Student must have completed related drawing/painting/printmaking coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

- A. Drawing
- B. Painting (materials fee)
- H. Honors (materials fee)
- P. Printmaking (materials fee)

Courses Primarily for Graduate Students, open to qualified undergraduate students

ArtDP 530. Drawing. (Dual-listed with 430.) (0-6) Cr. 3 each time taken, maximum of 9. F. *Prereq:* *Graduate classification, permission of instructor.* Figurative and/or non-figurative drawing with advanced work in media, composition, and theory. Materials fee.

ArtDP 538. Painting. (Dual-listed with 438.) (0-6) Cr. 3 each time taken, maximum of 9. F.S. *Prereq:* *Graduate classification, permission of instructor.* Figurative and/or non-figurative painting with

advanced work in media, composition, and theory. Materials fee.

ArtDP 556. Relief Printmaking. (Dual-listed with 356.) (0-6) Cr. 3 each time taken, maximum of 6. F. *Prereq:* *Graduate classification, permission of instructor.* Woodcut and linoleum cut printmaking process in black and white, multiblock color, and reduction color printing. Collographs and forms of relief printmaking used separately and in combination with woodcuts. Materials fee.

ArtDP 557. Monotype. (Dual-listed with 357.) (0-6) Cr. 3 each time taken, maximum of 6. S. *Prereq:* *Graduate classification, permission of instructor.* Monoprint and monotype processes; black and white and color techniques. Basic knowledge, production procedures, and drawing skills; experimentation. Materials fee.

ArtDP 558. Lithography. (Dual-listed with 358.) (0-6) Cr. 3 each time taken, maximum of 6. F.S. *Prereq:* *Graduate classification, permission of instructor.* Planographic printmaking process: theory and practice. Studio procedures, drawing, and printing skills applied to metal plate lithography. Materials fee.

ArtDP 559. Intaglio. (Dual-listed with 359.) (0-6) Cr. 3 each time taken, maximum of 6. F.S. *Prereq:* *Graduate classification, permission of instructor.* Intaglio printmaking processes. Basic knowledge and production procedures, drawing, and printing skills. Materials fee.

ArtDP 590. Special Topics. Cr. arr. *Prereq:* *Bachelor's degree in art and/or design, or evidence of satisfactory equivalency in specialized area. Written approval of instructor and department chair on required form in advance of semester of enrollment.*

- A. Drawing
- B. Painting (materials fee)
- P. Printmaking (materials fee)

Art Education (ArtEd)

Courses Primarily for Undergraduate Students

ArtEd 211. Introduction to Art Education. (0-6) Cr. 3. F.S. Design art experiences for the K-12 classroom. Hands on discipline specific and integrated art activities; emphasis on thinking skills. Materials fee.

ArtEd 313. Practicum: Art Education. Arr. Cr. 1 each time taken, maximum of 3. F.S. *Prereq:* *Credit or enrollment in 211, permission of instructor in advance of semester of enrollment.* Field experience in K-12 or community art education program.

ArtEd 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq:* *Written approval of instructor and department chair on required form in advance of semester of enrollment.* Student must have completed art and/or education coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

- H. Honors

Courses Primarily for Graduate Students, open to qualified undergraduate students

ArtEd 513. Introduction to New Art Basics. Cr. 3 or may be taken for CEU credit. SS. *Prereq:* *Permission of instructor.* Taught in 2 week workshop format; and extended instruction and exploration over the World Wide Web. Overview of higher order thinking skills instruction for visualization, visual thinking, metaphoric thinking, visual logic, and human, cultural, and historic contexts. Design of discipline-specific thinking skills strategies. Some sections will be taught entirely on the World Wide Web. Materials fee.

ArtEd 514. Multicultural Perspectives. (3-0) Cr. 3. F. *Prereq:* *Graduate classification, permission of instructor.* Understanding the nature, roles, and functions of the visual arts. Designing methodology for effective classroom instruction in human, cultural, and historical contexts. Observation and teaching experience at classroom based research site. Field trip fee, materials fee.

ArtEd 515. Visual Thinking Skills Education. (3-0) Cr. 3. S. *Prereq:* 513, admission to the graduate program in art education. Using theory to inform and direct the design of teaching methodology. Effective classroom techniques for promoting visual ideation. Experience in applied teaching research at classroom based research site. Materials fee.

ArtEd 516. Classroom Research Seminar. (3-0) Cr. 3. F. *Prereq:* 514, 515. Classroom based research theory and practice. Review of literature for individual research in visual education. Focused graduate research pilot project in K-12 classroom. Field trip fee, materials fee.

ArtEd 517. Teaching Practicum. Arr. Cr. 3 to 6, maximum of 6. S. *Prereq:* 516, all courses in the art education program; advanced registration required. Supervised experience and individually designed applied research in teaching art in elementary school.

ArtEd 518. Teaching Practicum. Arr. Cr. 3 to 6, maximum of 6. S. *Prereq:* 516, all courses in the art education program; advanced registration required. Supervised experience and individually designed applied research in teaching art in secondary school.

ArtEd 590. Special Topics. Cr. arr. *Prereq:* *Bachelor's degree in art and/or design, or evidence of satisfactory equivalency in specialized area. Written approval of instructor and department chair on required form in advance of semester of enrollment.*

ArtEd 593. Workshop. Cr. 1 to 3 each time taken. SS. *Prereq:* *Graduate classification; evidence of satisfactory experience in area of specialization.* Intensive exploration of art education related topic. Topics vary each time offered. Materials fee.

ArtEd 599. Creative Component. Cr. var. *Prereq:* *Concurrent enrollment or credit in 517 and/or 518.* Individually focused discipline-specific applied classroom research. Written summary of research; exhibition of research results.

Graphic Design (ArtGr)

Courses Primarily for Undergraduate Students

ArtGr 177. Introduction to Graphic Design. (2-0) Cr. 2. S. *Prereq:* Art 108, credit or enrollment in Art 109, 130, Dsn S 121. Historical, cultural, and social issues related to the practice of visual communication. Field trip fee, materials fee.

ArtGr 270. Graphic Design Studio I. (0-6) Cr. 3. F. *Prereq:* Art 109, 130, ArtGr 177, Dsn S 121, enrollment in 275; admission to the graphic design program through department review. Basic design concepts and color principles used for visual communication. Conceptual and analytical thinking skills through projects and discussions. Decision making for effective visual communication. Field trip fee, materials fee.

ArtGr 271. Graphic Design Studio II. (0-6) Cr. 3. S. *Prereq:* Art 230, ArtGr 270, 275, enrollment in 276. Principles of typographic composition, structure and hierarchy. Formal and conceptual principles of symbolism. Field trip fee, materials fee.

ArtGr 275. Graphic Technology I. (0-4) Cr. 2. F. *Prereq:* enrollment in 270. Basic computer skills for graphic design. Materials fee.

ArtGr 276. Graphic Technology II. (0-4) Cr. 2. S. *Prereq:* 275, enrollment in 271. Basic computer skills for graphic design. Materials fee.

ArtGr 277. Graphic Design Internship Seminar. (1-0) Cr. 1. F. *Prereq:* *Credit or enrollment in 270, 275.* Procedural and ethical concerns related to the graphic design internship. Personal goals, preparation of résumé and plans for internship. Offered on a satisfactory-fail grading basis only. Materials fee.

ArtGr 370. Graphic Design Studio III. (0-6) Cr. 3. F. *Prereq:* 271, 276, enrollment in a 2-credit option; credit or enrollment in 387. Creation and design of images and symbols for communication. Application and integration of typography with images and symbols. Field trip fee, materials fee.

ArtGr 371. Graphic Design Studio IV. (0-6) Cr. 3. S. *Prereq:* 370, 387, enrollment in a 2-credit option,

credit or enrollment in 388. Development and preparation of design concepts for application to the printing and electronic publishing process. Creative problem-solving skills, introduction to systems design. Field trip fee, materials fee.

ArtGr 387. Graphic Design History/Theory/Criticism I. (Dual-listed with 587.) (3-0) Cr. 3. F. *Prereq: Art H 280, 281, Dsn S 121.* Late nineteenth century to the 1960s, to provide understanding of the development and character of graphic design. Influential forces, artists, and designers. Materials fee. Nonmajor graduate credit.

ArtGr 388. Graphic Design History/Theory/Criticism II. (Dual-listed with 588.) (3-0) Cr. 3. S. *Prereq: 387.* Theory and history of contemporary graphic design including designers from the 1960s-present. Analysis of the way new materials and technology are leading to present design forms. Materials fee. Nonmajor graduate credit.

ArtGr 470. Graphic Design Studio V. (0-6) Cr. 3. F. *Prereq: 371, enrollment in a 2-credit option.* Advanced design systems as applied to corporate identity and environmental graphic design. Symbology as an integrated component of communication systems. Field trip fee, materials fee.

ArtGr 471. Graphic Design Studio VI. (0-6) Cr. 3. S. *Prereq: 470, enrollment in a 2-credit option.* Exploration of theoretical and conceptual concerns of visual communication. Portfolio preparation. Field trip fee, materials fee.

ArtGr 472. Photographic Art Direction. (0-4) Cr. 2. *Prereq: 271, 276, enrollment in 370 or 371, or 470 or 471.* Photography as a graphic design component. Compositional and conceptual elements in photographic images. Must have a camera with adjustable shutter speeds and lens openings. Field trip fee, materials fee.

ArtGr 474. Exhibition Design. (0-4) Cr. 2. *Prereq: 271, 276, enrollment in 370 or 371 or 470 or 471.* Visual communication applied to exhibition design focusing on educational or interactive museum exhibitions, trade show booth design, and modular unit design for traveling exhibitions. Translation of graphic information to a three-dimensional space. Field trip fee, materials fee.

ArtGr 475. Advanced Typography. (0-4) Cr. 2. *Prereq: 271, 276, enrollment in 370 or 371 or 470 or 471.* Typographic theory exploring traditional and nontraditional forms, both historical and contemporary typographic achievements. Field trip fee, materials fee.

ArtGr 476. Graphic Design Methodology. (0-4) Cr. 2. *Prereq: 271, 276, enrollment in 370 or 371 or 470 or 471.* Analysis and application of scientific, systematic, and nontraditional problem-solving and problem-seeking techniques. Field trip fee, materials fee.

ArtGr 477. Graphic Design Practicum. (0-6) Cr. 2 each time taken, maximum of 4. *Prereq: 370, portfolio review and permission of instructor.* Graphic design outreach and problem solving. Individual and group projects for non-profit clients selected by the instructor. Field trip fee, materials fee.

ArtGr 479. Environmental Graphics. (0-4) Cr. 2. *Prereq: 271, 276, enrollment in 370 or 371 or 470 or 471.* Functional and aesthetic implications of environmental communication. Way-finding systems such as transportation graphics, architectural signage. Environmental graphics for community or corporate identity systems. Field trip fee, materials fee.

ArtGr 480. Graphic Design Internship. Arr. Cr. 3. *Prereq: 277, 12 credits in graphic design; permission of instructor, registration in advance of enrollment.* Graphic design experience in an off-campus professional environment. Materials fee.

ArtGr 481. Graphic Design Professional Practices. (3-0) Cr. 3. F. *Prereq: Credit or enrollment in 470.* Professional design management; ethics, setting up a new business, client/designer relationships, contractual options, billing practices, and effective operating procedures. Field trip fee, materials fee.

ArtGr 484. Selected Studies in Graphic Design. Cr. 1 to 3 each time taken, maximum of 9. F.S. *Prereq: Permission of instructor.* Special issues relat-

ed to graphic design. Topics vary each time offered. Field trip fee, materials fee.

ArtGr 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq: Written approval of instructor and department chair on required form in advance of semester of enrollment.* Student must have completed related graphic design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

- A. Theory, Criticism, and Methodology (materials fee)
- B. Two-Dimensional Design (materials fee)
- C. Three-Dimensional Design (materials fee)
- H. Honors (materials fee)
- I. Internship/Cooperative (in-depth experience other than ArtGr 480; satisfactory-fail only) (Materials fee).

ArtGr 493. Workshop. Cr. 1 to 3 each time taken. SS. *Prereq: Evidence of satisfactory experience in area of specialization.* Intensive 2 to 4 week studio exploration. Topics vary each time offered. Materials fee.

Courses Primarily for Graduate Students, open to qualified undergraduate students

ArtGr 570. Advanced Studies in Visual Communication. (0-10) Cr. 5. F. *Prereq: Graduate classification.* Theory and investigation of systems, structures, principles of visual organization, and typography for communication. Studio problems will be influenced by social, cultural, environmental, or technological factors. Field trip fee, materials fee.

ArtGr 571. Signs, Symbols, Images. (0-10) Cr. 5. S. *Prereq: 570.* Investigation and application of signs, symbols and semiotic theory for communication. Studio problems will be influenced by social, cultural, environmental, or technological factors. Field trip fee, materials fee.

ArtGr 584. Selected Studies in Graphic Design. Cr. var. *Prereq: Graduate classification, permission of instructor.* Special issues related to graphic design. Topics vary each time offered; may be repeated. Field trip fee, materials fee.

ArtGr 587. Graphic Design History/Theory/Criticism I. (Dual-listed with 387.) (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor.* Late nineteenth century to the 1960s, to provide understanding of the development and character of graphic design. Influential forces, artists, and designers. Materials fee.

ArtGr 588. Graphic Design History/Theory/Criticism II. (Dual-listed with 388.) (3-0) Cr. 3. S. *Prereq: Graduate classification, permission of instructor.* Theory and history of contemporary graphic design including designers of the 1960s - present. Analysis of the way new materials and technology are leading to present design forms. Materials fee.

ArtGr 590. Special Topics. Cr. arr. *Prereq: Bachelor's degree in graphic design, or evidence of satisfactory equivalency in specialized area. Written approval of instructor and department chair on required form in advance of semester of enrollment.*

- A. Theory, Criticism, and Methodology (materials fee)
- B. Two-Dimensional Design (materials fee)
- C. Three-Dimensional Design (materials fee)

ArtGr 593. Workshop. Cr. 1 to 3 each time taken. SS. *Prereq: Graduate classification; evidence of satisfactory experience in area of specialization.* Intensive 2 to 4 week studio exploration. Topics vary each time offered. Materials fee.

Courses for Graduate Students

ArtGr 672. Graphic Design and Human Interaction. (0-10) Cr. 5 each time taken, maximum of 10. F.S. *Prereq: 570, 571.* Exploration and design of the interface/interaction with products, systems, and technologies of contemporary society and culture. Studio problems may involve such areas as: exhibition design, electronic interface design, wayfinding, packaging design, and publication design. Field trip fee, materials fee.

ArtGr 690. Advanced Topics. Cr. arr. *Prereq: MFA classification, permission of instructor.* Materials fee.

ArtGr 699. Research. Cr. var.

- A. Thesis
- B. Thesis-Exhibition

Interior Design (ArtID)

Courses Primarily for Undergraduate Students

ArtID 160. Interior Design Foundations. (3-0) Cr. 3. S. *Prereq: Art 108 or equivalent.* The profession, issues, and the role of interior design. Field trip fee, materials fee.

ArtID 160S. Interior Design Foundations Studio. (0-6) Cr. 3. S. *Prereq: Art 108, 130, credit or enrollment in Art 109, ArtID 160, Dsn S 121.* Creative problem solving methods, rapid visualization techniques and computer-based methods of managing design text information. Small scale projects. Field trip fee, materials fee.

ArtID 161. Graphic Communication for Interior Designers. (Same as Dsn S 161.) (2-4) Cr. 3. F.S. Proficiency in the development of technical and design drawing with drafting instruments. Emphasis on drawing layout, line quality, and lettering. Site and structure measurement, dimensioning, single and multiview drawings, sections, and pictorial drawing systems including perspective. Presentation drawings, shades, shadows, and reflections. Materials fee.

ArtID 265. Interior Design Studio I. (1-9) Cr. 4. F. *Prereq: Art 109, Dsn S 121, ArtID 160, 167, credit or enrollment in Dsn S 101, enrollment in ArtID 350 or Arch 240; admission to the interior design program through department review.* Enhanced creative interior design problem solving, compositional theories and graphic communication as applied to the interior design of small scale environments. Manual visualization techniques. Field trip fee, materials fee.

ArtID 267. Interior Design Studio II. (1-9) Cr. 4. S. *Prereq: 265, 350 or Arch 240, Dsn S 101, enrollment in 351 and 355, credit or enrollment in T C 104.* Human factors issues including ergonomics, human behavior and the requirements of special groups. Residential interior design and medium scale projects. Detail drawings, and expansion of visualization techniques. Field trip fee, materials fee.

ArtID 269. Interior Design Computer Applications. (0-6) Cr. 3. F. *Prereq: Enrollment in 265.* Computer techniques and applications; projects employing computer-graphic methods. Field trip fee, materials fee.

ArtID 350. Interior Systems I. (4-0) Cr. 4. *Prereq: Admission to the interior design program through department review.* Structural principles, mechanical systems, and standard construction methods as related to interior design. Field trip fee, materials fee.

ArtID 351. Interior Systems II. (3-0) Cr. 3. S. *Prereq: 265, 350 or Arch 240.* Manufactured furniture, interior finishes and related issues. Selection criteria and written specifications. Field trip fee, materials fee.

ArtID 352. Interior Systems III. (3-0) Cr. 3. F. *Prereq: 351 and enrollment in 365.* Light and color as related to interior spaces. Lighting principles, and techniques to implement lighting design objectives. Field trip fee, materials fee.

ArtID 353. Interior Systems IV. (3-0) Cr. 3. S. *Prereq: 352 and enrollment in 367.* Specialized interior assemblies and interface with related building systems. Detailing and documentation. Field trip fee, materials fee.

ArtID 355. Interior Design History/Theory/Criticism I. (3-0) Cr. 3. S. *Prereq: Dsn S 121.* Stylistic evaluation of interior finishes, furnishings, and decorative arts, from a critical, historic and multicultural perspective. Field trip fee, materials fee. Nonmajor graduate credit.

ArtID 356. Interior Design History/Theory/Criticism II. (3-0) Cr. 3. F. *Prereq: Dsn S 121.* Theoretical approaches to the design of interior space, from a critical, historic and multicultural perspective, including late twentieth century. Field trip fee, materials fee. Nonmajor graduate credit.

ArtID 359. Junior Field Study. Cr. R. F. *Prereq:* Enrollment in third year studio course. Study and tours of manufacturers, designers, retailers, museums and other areas of interest within the interior design profession. Offered on a satisfactory-fail grading basis only. Field trip fee, materials fee.

ArtID 365. Interior Design Studio III. (1-9) Cr. 4. F. *Prereq:* 267, 351, T C 104, enrollment in 352 and 356. Formal methods of design programming and problem identification. Also includes conceptualization and problem solving related to work environments and special populations. Large scale projects. Alternative manual and computer-based visualization methods. Teamwork. Field trip fee, materials fee.

ArtID 367. Interior Design Studio IV. (1-9) Cr. 4. S. *Prereq:* 352, 365, credit or enrollment in 353, 369. Emphasis on three-dimensional spatial perception in large multiple scale institutional projects. Expansion of alternative manual and computer-based visualization methods. Teamwork. Field trip fee, materials fee.

ArtID 368. International Study Orientation Seminar. (1-0) Cr. 1. S. *Prereq:* 365, permission of instructor and planned enrollment in Rome study option. Historic and contemporary architecture and interior design, customs and traditions of Rome and related travel itinerary locations. Required of students participating in the interior design international study option. Offered on a satisfactory-fail grading basis only. Materials fee.

ArtID 369. Interior Design Internship Seminar. (1-0) Cr. 0.5, to be repeated for 1 credit. F.S. *Prereq:* Credit or enrollment in 367. Procedural and ethical concerns relating to interior design internship. Preparation of placement credentials and formulation of personal goals. Internship plans and agreements. Materials fee. Offered on a satisfactory-fail basis only.

ArtID 459. Senior Field Study. Cr. R. *Prereq:* Enrollment in fourth year studio course. Study and tours of manufacturers, designers, retailers, museums and other areas of interest within the interior design profession. Offered on a satisfactory-fail grading basis only. Field trip fee, materials fee.

ArtID 460. Interior Design Internship. Arr. Cr. 3. S.S. *Prereq:* Satisfactory completion of all 300-level interior design coursework and Arch 240. Professional interior design off-campus experience. Materials fee.

ArtID 461. Interior Design Professional Practices. (2-0) Cr. 2. S. *Prereq:* 460. Organization and general management of the interior design office: agreements, business procedures, professional ethics. Field trip fee, materials fee.

ArtID 463. Housing Environments for Elderly and Disabled Persons. (HD FS 463.) See *Human Development and Family Studies*.

ArtID 464. Selected Studies in Interior Design. (Dual-listed with 564.) Cr. 2 or 3 each time taken, maximum of 9. *Prereq:* 12 credits in design related courses and permission of instructor. Special issues with emphasis on their translation into design application. Topics vary each time offered. Field trip fee, materials fee. Nonmajor graduate credit.

ArtID 465. Interior Design Studio V. (Dual-listed with 565.) (1-9) Cr. 4. F. *Prereq:* 460, credit or enrollment in 461. Design research and refined problem solving methods including functional analysis, programming and detailing. Multi-cultural. Study abroad option. Field trip fee, materials fee. Nonmajor graduate credit.

ArtID 467. Interior Design Studio VI. (1-9) Cr. 4. S. *Prereq:* 465 and all required interior systems and history/theory/criticism courses. Refinement of technical, analytical and theoretical problem-solving methods and comprehensive design documentation. In-depth development of individual projects. Current issues in interior design. Field trip fee, materials fee. Nonmajor graduate credit.

ArtID 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* Written approval of instructor and department chair on required form in advance of semester of enrollment. Student must have completed related interior design coursework appropriate to

planned independent study. Offered on a graded basis or a satisfactory-fail basis. Materials fee. H. Honors

ArtID 493. Workshop. Cr. 1 to 3 each time taken. SS. *Prereq:* Evidence of satisfactory experience in area of specialization. Intensive 2 to 4 week studio exploration. Topics vary each time offered. Materials fee.

Courses Primarily for Graduate Students, open to qualified undergraduate students

ArtID 564. Selected Studies in Interior Design. (Dual-listed with 464.) Cr. 2 or 3 each time taken, maximum of 9. *Prereq:* 12 credits in design related courses, permission of instructor. Special issues with emphasis on their translation into design application. Topics vary each time offered. Field trip fee, materials fee.

ArtID 565. Interior Design Studio. (Dual-listed with 465; same as Hous 565.) (2-9) Cr. 5. F. *Prereq:* Graduate classification. Design research and refined problem-solving methods including functional analysis, programming and detailing. Multi-cultural, small and medium sized design. Study abroad option. Field trip fee, materials fee.

ArtID 567. Interior Design Studio. (2-9) Cr. 5. F.S. *Prereq:* Graduate classification. Design research and interior design problem solving. Field trip fee, materials fee.

ArtID 590. Special Topics. Cr. arr. *Prereq:* Bachelor's degree in interior design, or evidence of satisfactory equivalency in specialized area. Written approval of instructor and department chair on required form in advance of semester of enrollment. Materials fee.

ArtID 593. Workshop. Cr. 1 to 3 each time taken. SS. *Prereq:* Graduate classification: evidence of satisfactory experience in area of specialization. Intensive 2 to 4 week studio exploration. Topics vary each time offered. Materials fee.

Courses for Graduate Students

ArtID 660. Research Methods. (Same as Hous 660) (3-0) Cr. 3. F.S. *Prereq:* Permission of instructor. Research strategies related to interior design. Application of selected methods to specific issues. Materials fee.

ArtID 665. Advanced Interior Design Studio. (0-9) Cr. 3 each time taken, maximum of 15. F.S. *Prereq:* Graduate classification. Interior design problem-solving with emphasis on special issues. Project types will include but not be restricted to hospitality, health care, institutional, industrial, residential, historic preservation and commercial environments. Field trip fee, materials fee.

ArtID 690. Advanced Topics. Cr. arr. *Prereq:* M.F.A. classification, permission of instructor. Materials fee.

ArtID 699. Research. Cr. var.
A. Thesis
B. Thesis-Exhibition

Art History (Art H)

Courses Primarily for Undergraduate Students

Art H 181. History of Design. (Same as Dsn S 181.) (3-0) Cr. 3. F.S. Study of issues and artifacts, their relation to the traditional and changing role of the creators, and to western culture.

Art H 280. History of Art I. (Same as Dsn S 280.) (3-0) Cr. 3. Yr. Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts. From prehistoric through Gothic. Materials fee.

Art H 281. History of Art II. (Same as Dsn S 281.) (3-0) Cr. 3. Yr. Development of the visual arts of western civilization including painting, sculpture, architecture, and crafts. From the Renaissance to the twentieth century. Materials fee.

Art H 376. Environmental Art. (Dual-listed with 576; same as L A 376.) See *Landscape Architecture*.

Art H 380. North American Indian Art. (Dual-listed with 580; same as Dsn S 380.) (3-0) Cr. 3. Alt. S., offered 2000. Visual art forms of North American Indian people, from prehistoric through contemporary. Survey of major cultural areas and individual artist; emphasis on the cultural context of their artistic production. Field trip fee, materials fee. Nonmajor graduate credit.

Art H 381. Art and Architecture of India. (Dual-listed with 581; same as Dsn S 381.) (3-0) Cr. 3. Alt. F., offered 1999. South Asian art and architecture from earliest times to the present day. Development of style; social uses and symbolism that give imagery its meaning. Field trip fee, materials fee. Nonmajor graduate credit.

Art H 382. Art and Architecture of Asia. (Dual-listed with 582; same as Dsn S 382.) (3-0) Cr. 3. Alt. S., offered 2000. A selective history of visual imagery from a variety of major Asian traditions, chiefly India, China, Japan, Sri Lanka, Cambodia, and Indonesia. Field trip fee, materials fee. Nonmajor graduate credit.

Art H 383. Greek and Roman Art. (Dual-listed with 583; same as Dsn S 383.) (3-0) Cr. 3. Alt. S., offered 2001. Greek art from Neolithic and Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West. Field trip fee, materials fee. Nonmajor graduate credit.

Art H 385. Renaissance Art. (Dual-listed with 585; same as Dsn S 385.) (3-0) Cr. 3. Alt. S., offered 2000. European art including painting, sculpture, architecture, and crafts: thirteenth through sixteenth centuries. Field trip fee, materials fee. Nonmajor graduate credit.

Art H 386. Baroque and Rococo Art. (Dual-listed with 586; same as Dsn S 386.) (3-0) Cr. 3. Alt. F., offered 2000. European art including painting, sculpture, architecture, and crafts: seventeenth and eighteenth centuries. Field trip fee, materials fee. Nonmajor graduate credit.

Art H 387. Nineteenth Century Art. (Dual-listed with 587; same as Dsn S 387.) (3-0) Cr. 3. Alt. F., offered 1999. European and American art and architecture from 1780 to 1900 focusing on the major monuments of western Europe: Neo-Classicism, Romanticism, Realism, Impressionism, and Post-Impressionism. Field trip fee, materials fee. Nonmajor graduate credit.

Art H 388. Modernism and Modern Art: 1880-1945. (Dual-listed with 588; same as Dsn S 388.) (3-0) Cr. 3. Alt. F., offered 2000. Painting, sculpture, crafts, architecture, photography, and cinema from Post-Impressionism to Surrealism. Field trip fee, materials fee. Nonmajor graduate credit.

Art H 389. European and American Art: 1945-1970. (Dual-listed with 589; same as Dsn S 389.) (3-0) Cr. 3. Alt. F., offered 1999. Painting, sculpture, crafts, architecture, photography, cinema and video in the post war period. Field trip fee, materials fee. Nonmajor graduate credit.

Art H 394. Women in Art. (Dual-listed with 594; same as Dsn S 394, W S 394.) (3-0) Cr. 3. Alt. S., offered 2001. Lives, careers, and achievements of women artists and the related cultural environment from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically feminist issues in art that are becoming widespread in the artistic culture. Field trip fee, materials fee. Nonmajor graduate credit.

Art H 395. Contemporary Art and Theory Since 1970. (Dual-listed with 595; same as Dsn S 395.) (3-0) Cr. 3. Alt. S., offered 2000. Visual arts and critical theory from 1970 to the present. Field trip fee, materials fee. Nonmajor graduate credit.

Art H 396. History of Photography. (Dual-listed with 596; same as Dsn S 396.) (3-0) Cr. 3. Alt. F., offered 2000. Survey of the evolution of photography and photojournalism from the 1830s to the present, seen from an art historical perspective, emphasizing causative factors, cultural influences, and major masters and schools. Field trip fee, materials fee. Nonmajor graduate credit.

Art H 398. Selected Topics in Art History. (Dual-listed with 598; same as Dsn S 398.) (3-0) Cr. 3 each time taken, maximum of 9. Specialized study in the history or criticism of art and/or design. Field trip fee, materials fee.

Art H 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* Written approval of instructor and department chair on required form in advance of semester of enrollment. Student must have completed art history coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

H. Honors

Courses Primarily for Graduate Students, open to qualified undergraduate students

Art H 576 Environmental Art. (Dual-listed with 376; same as L A 576.) See *Landscape Architecture*.

Art H 580. North American Indian Art. (Dual-listed with 380; same as Dsn S 580.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* Graduate classification, permission of instructor. Visual art forms of North American Indian people, from prehistoric through contemporary. Survey of major cultural areas and individual artists; emphasis on the cultural context of their artistic production. Field trip fee, materials fee.

Art H 581. Art and Architecture of India. (Dual-listed with 381; same as Dsn S 581.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* Graduate classification, permission of instructor. South Asian art and architecture from earliest times to the present day. Development of style; social uses and symbolism that give imagery its meaning. Field trip fee, materials fee.

Art H 582. Art and Architecture of Asia. (Dual-listed with 382; same as Dsn S 582.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* Graduate classification, permission of instructor. Selective history of visual imagery from a variety of major Asian traditions, chiefly India, China, Japan, Sri Lanka, Cambodia, and Indonesia. Field trip fee, materials fee.

Art H 583. Greek and Roman Art. (Dual-listed with 383; same as Dsn S 583.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* Graduate classification, permission of instructor. Greek art from Neolithic and Hellenistic periods. Roman art from the traditional founding to the end of the empire in the West. Field trip fee, materials fee.

Art H 585. Renaissance Art. (Dual-listed with 385; same as Dsn S 585.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* Graduate classification, permission of instructor. European art including painting, sculpture, architecture, and crafts; thirteenth through sixteenth centuries. Field trip fee, materials fee.

Art H 586. Baroque and Rococo Art. (Dual-listed with 386; same as Dsn S 586.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* Graduate classification, permission of instructor. European art including painting, sculpture, architecture, and crafts; seventeenth and eighteenth centuries. Field trip fee, materials fee.

Art H 587. Nineteenth Century Art. (Dual-listed with 387; same as Dsn S 587.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* Graduate classification, permission of instructor. European and American art and architecture from 1780 to 1900, focusing on the major monuments of western Europe: Neo-Classicism, Romanticism, Realism, Impressionism, and Post-Impressionism. Field trip fee, materials fee.

Art H 588. Modernism and Modern Art: 1880-1945. (Dual-listed with 388; same as Dsn S 588.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* Graduate classification, permission of instructor. Painting, sculpture, crafts, architecture, photography, and cinema from Post-Impressionism to Surrealism. Field trip fee, materials fee.

Art H 589. European and American Art: 1945-1970. (Dual-listed with 389; same as Dsn S 589.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* Graduate classification, permission of instructor. Painting, sculpture, crafts, architecture, photography, cinema and video in the postwar period. Field trip fee, materials fee.

Art H 590. Special Topics. Cr. arr. *Prereq:* Bachelor's degree in art and/or design, or evidence of satisfactory equivalency in specialized area. Written approval of instructor and department chair on required form in advance of semester of enrollment.

Art H 594. Women in Art. (Dual-listed with 394; same as Dsn S 594, W S 594.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* Graduate classification, permission of instructor. Lives, careers, and achievements of women artists and the related cultural environment from the Middle Ages to contemporary times in Europe and America. Feminist movement beginning in the 1970s and specifically feminist issues in art that are becoming widespread in the artistic culture. Field trip fee, materials fee.

Art H 595. Contemporary Art and Theory Since 1970. (Dual-listed with 395; same as Dsn S 595.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* Graduate classification, permission of instructor. Visual arts and critical theory from 1970 to the present. Field trip fee, materials fee.

Art H 596. History of Photography. (Dual-listed with 396; same as Dsn S 596.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* Graduate classification, permission of instructor. Survey of the evolution of photography and photojournalism from the 1830s to the present, seen from an art historical perspective, emphasizing causative factors, cultural influences, and major masters and schools. Field trip fee, materials fee.

Art H 598. Selected Topics in Art History. (Dual-listed with 398; same as Dsn S 598.) (3-0) Cr. 3 each time taken, maximum of 9. *Prereq:* Graduate classification, permission of instructor. Specialized study in the history or criticism of art and/or design. Field trip fee, materials fee.

Visual Studies (ArtVS)

Courses Primarily for Undergraduate Students

ArtVS 202. Calligraphy. (0-6) Cr. 3. F.S. *Prereq:* Art 108 and 130 or equivalent design/drawing coursework. Direct stroke letters for calligraphy. Applied design applications. Materials fee.

ArtVS 208. Color. (0-6) Cr. 3. F.S. *Prereq:* Art 108 or 130 or equivalent design/drawing coursework. The impact of changing visual relationships emphasizing color concepts. Pigment mixing and interaction exercises, using various color systems. Materials fee.

ArtVS 229. Design Through Photography I. (0-6) Cr. 3. F.S. Photography as a medium of design. Camera use and dark room processes. Must have a camera with shutter. Field trip fee, materials fee.

ArtVS 300. Sources of Visual Design. (0-6) Cr. 3. F. *Prereq:* Art 109, 230. Studio exercises to develop awareness of external and internal sources for design. Materials fee.

ArtVS 302. Intermediate Calligraphy. (0-6) Cr. 3 each time taken, maximum of 6. F. *Prereq:* 202. Design with calligraphic alphabets. Two-dimensional and three-dimensional applications. Materials fee. Nonmajor graduate credit.

ArtVS 303. Design with Calligraphic Letterforms. (0-6) Cr. 3 each time taken, maximum of 6. S. *Prereq:* 202. Combining calligraphic alphabet styles using a variety of tools including the copperplate pen. Two-dimensional and book applications. Materials fee. Nonmajor graduate credit.

ArtVS 304. Papermaking. (0-6) Cr. 3 each time taken, maximum of 6. Alt. S., offered 2001. *Prereq:* 6 credits in studio work. Papermaking as a creative forming process. Three-dimensional applications. Materials fee. Nonmajor graduate credit.

ArtVS 305. Two-Dimensional Mixed Media. (Dual-listed with 505.) (0-6) Cr. 3 each time taken, maximum of 6. F.S. *Prereq:* 12 credits in design and/or drawing. Exploration and application of various materials, techniques, and ideas. Materials fee.

ArtVS 306. Three-Dimensional Mixed Media. (Dual-listed with 506.) (0-6) Cr. 3 each time taken, maximum of 6. F.S. *Prereq:* 12 credits in design and/or drawing. Exploration and understanding of

three-dimensional form/space relationships through additive and manipulative processes. Materials fee.

ArtVS 326. Introduction to Illustration. (Same as BPM I 326.) (0-6) Cr. 3. F. *Prereq:* ArtDP 238. Application of painting, drawing, and image making techniques to communication. Development of technical facilities in a variety of illustration media. The past and current state of illustration and the role of typography and its integration with illustration. Digital and print production techniques. Materials fee.

ArtVS 327. Illustration as Communication and Interpretive Expression. (Same as BPM I 327.) (0-6) Cr. 3. S. *Prereq:* 326. Studio problems in illustration covering editorial, advertising, and narrative expression. Problem solving methodologies. Materials fee.

ArtVS 329. Design Through Photography II. (0-6) Cr. 3 each time taken, maximum of 9. F.S. *Prereq:* 229 or JM C 309 and 310 or equivalent photography course. Photography as a pliable medium of art and design. Must have camera with adjustable shutter speeds and lens openings. Field trip fee, materials fee.

ArtVS 335. Three-Dimensional Studio. (Same as Arch 335.) (0-6) Cr. 2 each time taken, maximum of 8. F.S. Sculptural media: modeling in clay, wood carving, stone carving, casting in plaster and metal, welding, and other constructing techniques. Field trip fee, materials fee.

ArtVS 336. Biological Illustration Principles and Techniques. (Same as BPM I 336.) (0-6) Cr. 3 each time taken, maximum of 6. F. *Prereq:* 6 credits in art and design and 3 credits in the biological sciences. Studio basics and fundamentals of traditional biological rendering techniques. Emphasis on tools and materials. Materials fee.

ArtVS 337. Application of Biological Illustration Techniques. (Same as BPM I 337.) (0-3) Cr. 3 each time taken, maximum of 6. S. *Prereq:* 336. Rendering techniques applied to different types of biological subject matter including computer and air-brush applications. Term project required. Materials fee.

ArtVS 408. Computer-aided Art and Design. (Dual-listed with 508.) (0-6) Cr. 3 each time taken, maximum of 9. F.S. *Prereq:* Permission of instructor. The computer, software and related techniques as pliant media for art and design. Emphasis on use as a tool for concept development, alternative problem solving, communication, pathfinding, and exploration of visual vocabulary, as they apply to still and animated imagery. Materials fee. Nonmajor graduate credit.

ArtVS 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* Written approval of instructor and department chair on required form in advance of semester of enrollment. Student must have completed related design coursework appropriate to planned independent study. Offered on a graded basis or a satisfactory-fail basis.

- A. Two-Dimensional Media (materials fee)
- B. Three-Dimensional Media (materials fee)
- C. Calligraphy (materials fee)
- D. Computer Art and Design (materials fee)
- E. Illustration (materials fee)
- G. Photography (materials fee)
- H. Honors (materials fee)

ArtVS 493. Workshop. Cr. 1 to 3 each time taken. SS. *Prereq:* Evidence of satisfactory experience in area of specialization. Intensive 2 to 4 week studio exploration. Topics vary each time offered. Materials fee.

Courses Primarily for Graduate Students, open to qualified undergraduate students

ArtVS 505. Two-Dimensional Mixed Media. (Dual-listed with 305.) (0-6) Cr. 3 each time taken, maximum of 6. F.S. *Prereq:* Graduate classification, permission of instructor. Exploration and application of various materials, techniques, and ideas. Materials fee.

ArtVS 506. Three-Dimensional Mixed Media. (Dual-listed with 306.) (0-6 to 10) Cr. 3 each time taken, maximum of 6. F.S. *Prereq:* Graduate classification, permission of instructor. Exploration and

understanding of three-dimensional form/space relationships through additive and manipulative processes. Materials fee.

ArtVS 508. Computer-aided Art and Design. (Dual-listed with 408.) (0-6) Cr. 3 each time taken, maximum of 9. F.S. Prereq: *Graduate classification, permission of instructor.* The computer, software and related techniques as pliant media for art and design. Emphasis on use as a tool for concept development, alternative problem-solving, communication, pathfinding, and exploration of visual vocabulary, as they apply to still and animated imagery. Materials fee.

ArtVS 590. Special Topics. Cr. arr. Prereq: *Bachelor's degree in art and/or design, or evidence of satisfactory equivalency in specialized area. Written approval of instructor and department chair on required form in advance of semester of enrollment.*

- A. Two-dimensional Media (materials fee)
- B. Three-dimensional Media (materials fee)
- C. Calligraphy (materials fee)
- D. Computer Art and Design (materials fee)
- G. Photography (materials fee)
- I. Intermedia (materials fee)

ArtVS 593. Workshop. Cr. 1 to 3 each time taken. SS. Prereq: *Graduate classification; evidence of satisfactory experience in area of specialization.* Intensive 2 to 4 week studio exploration. Topics vary each time offered. Materials fee.

Astronomy and Astrophysics

For description of courses, see *Physics*.

Bacteriology

See *Microbiology*.

Biochemistry, Biophysics, and Molecular Biology

Marit Nilsen-Hamilton, Chair of Department

Distinguished Professors: Beltz, Graves, Olson

University Professors: Hammond, Horowitz

Professors: Applequist, Atherly, Fromm, Honzatko, Kostic, Myers, Nikolau, Nilsen-Hamilton, Robson, Robyt, Stromer, Thomas, White

Professors (Collaborators): Tabatabai

Distinguished Professors (Emeritus): Bremner, Metzler

Professors (Emeritus): Tipton

Associate Professors: Buss, Chitnis, Huiatt, Miller, Thornburg

Assistant Professors: Andreotti, Hargrove, Norris

Assistant Professors (Adjunct): James

Undergraduate Study

The department offers majors in biochemistry or biophysics in the College of Liberal Arts and Sciences and a major in agricultural biochemistry in the College of Agriculture.

Biochemists and biophysicists seek to understand life processes in terms of chemical and physical principles. They conduct research in the frontiers of biology such as metabolic networking; structure and function of enzymes, membranes, and hormones; computational

1999-2001

approaches; genomic and proteomic technology; protein engineering; plant biotechnology; muscle structure and function; and the design and evaluation of drugs for the treatment of disease. Biochemistry and biophysics provide the basis for much of modern biotechnology. Graduates have opportunities in industry, especially the biotechnology sector, in universities and medical schools, and government laboratories. Students who meet the necessary high scholastic standards continue their studies in a graduate college, medical school, or veterinary medical school.

Graduates of biochemistry, agricultural biochemistry and biophysics understand the chemical principles of biological systems including molecular biology. They have developed laboratory expertise in modern biochemical techniques, including the ability to analyze data and prepare scientific reports. Most have participated in undergraduate research and have developed the skills necessary for both written and oral presentations at a level that will serve the student both within the university and in postgraduate professional life. Graduates have the experience of interacting with persons of different background and cultures. Students have the background in mathematics and physics to solve problems of broad scope in biological, biomedical and environmental sciences and to provide leadership in diverse scientific and technological arenas.

Agricultural Biochemistry Major in the College of Agriculture

For the undergraduate curriculum leading to the degree bachelor of science, see *College of Agriculture, Curricula*. Agricultural biochemistry is recommended to students interested in the areas of agriculture requiring strong preparation in biochemistry, chemistry, physics, and mathematics, or in preparation for the study of veterinary medicine. Employment opportunities exist in agrochemical, animal and plant biotechnology.

Biochemistry or Biophysics Majors in the College of Liberal Arts and Sciences

For the undergraduate curriculum leading to the degree bachelor of science, see *Liberal Arts and Sciences, Curriculum*. Biochemistry and biophysics are recommended to students whose career interests involve advanced study or employment in biochemistry or biophysics, or in related areas of the biological or medical sciences.

Undergraduate majors in the College of Liberal Arts and Sciences in biochemistry usually have the following basic courses or their equivalents in their programs: BBMB 101, 102, 404, 405 (or 501, 502), 411, 461 or 551; Chem 177M, 177N, 178, 210 (or 211), 211L, 321, 322, 322L, 331, 332, 333L, 334L; Math 165, 166, 265 (or 266); Phys 221, 222; Biol 201, 201L (or 202L or 301L or 302L), 202, 301, 302, and a minimum of 4 additional credits of biological science courses from biology, botany, genetics, microbiology, and zoology. Undergraduate research, BBMB 499, is strongly recommended.

Undergraduate majors in biophysics usually include the following basic courses in their programs: BBMB 101, 461 or 551; Chem 177, 177L, 178, 210 (or 211), 321, 321L (or 322L or

Phys 311), 322, 331, 332, Math 165, 166, 265, 266; Phys 221, 222, 324 (or 321), and 232 or Com S 205; Biol 201, 201L (or 202L); Biol 202; and 9 additional credits in 300 or higher level courses in biochemistry, biophysics, biological sciences, chemistry, or physics. BBMB 404, 405 and Biol 301 are recommended in meeting this requirement for students preparing for careers in molecular biophysics. Students wishing a strong preparation for graduate studies are advised to take undergraduate research and further mathematics courses such as 385 and 465.

These lists of courses should not be regarded as statements of fixed requirements or as complete outlines of the work necessary for the major. They are given solely for the convenience of students or advisers who wish to estimate the amount of basic study that may be needed.

Biochemistry and biophysics majors are advised to meet the College of Liberal Arts and Sciences foreign language requirement with courses in French, German, or Russian.

See also the B.S./M.S. program under Graduate Study.

The department offers minors in biochemistry in both the College of Agriculture and the College of Liberal Arts and Sciences, which may be earned by credit in BBMB 404, 405, 311 (or 411), and 451 (or Chem 321), plus additional supporting 300 courses in chemistry or biochemistry for a total of 15 credits.

English proficiency requirement: Majors in agricultural biochemistry must complete Engl 104 and 105 and one course in speech fundamentals with a grade of C or better in each of these courses, and complete a communications intensive requirement equivalent to 3 credits from courses within the major. Majors in the College of Liberal Arts and Sciences must complete Engl 104 and 105 and one of the following with a grade of C- or better: (a) Engl 305, 309, or 314; (b) a written report in BBMB 411, or 499.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in biochemistry and biophysics and with interdepartmental majors in genetics, MCDB (molecular, cellular, and developmental biology), plant physiology, and toxicology. The department also participates in the interdepartmental program in immunobiology (see Index). Minor work is offered to students taking major work in other departments.

Prerequisite to graduate work is a sound undergraduate background in biology, chemistry, mathematics, and physics.

All graduate students are required by the department to teach as part of their training for an advanced degree.

The department offers a B.S./M.S. program in biochemistry that allows students to obtain both the B.S. and M.S. degrees in five years. The program is open to students in the College of Liberal Arts and Sciences and in the College of Agriculture. Students interested in this program should contact the department

office for details. Application for admission to the Graduate College should be made near the end of the junior undergraduate (third) year. Students would begin research for the M.S. thesis during the summer semester after their junior year and are eligible for research assistantships.

Courses open for nonmajor graduate credit: 404, 405, 411, 420, 451, 461.

Visit our departmental website at <http://molebio.iastate.edu/bb.html>/homepage.htm

Courses Primarily for Undergraduate Students

BBMB 101. Introduction to Biochemical Activities. (1-0) Cr. 1. F. Research activities, career opportunities in biochemistry and biophysics, and an introduction to the structure of biologically important compounds. For students considering a major in biochemistry or biophysics.

BBMB 102. Introduction to Biochemistry. (0-2) Cr. 1. S. *Prereq:* Credit or enrollment in Chem 177 and 177L. Topics in the scientific background of biochemistry, such as macromolecules, metabolism, and catalysis. May include laboratory experiments as well as literature readings and discussion. A significant component is practice in scientific communication. For students considering biochemistry as a major.

BBMB 221. Structure and Reactions in Biochemical Processes. (3-0) Cr. 3. F.S. *Prereq:* Chem 163, 167, or 177. Fundamentals necessary for an understanding of biochemical processes. Primarily for students in agriculture. Not acceptable for credit toward a major in biochemistry or biophysics. Credit for both 221 and Chem 231 may not be applied toward graduation.

BBMB 301. Survey of Biochemistry. (3-0) Cr. 3. F.S.SS. *Prereq:* Chem 231 or 331. A survey of biochemistry: structure and function of amino acids, proteins, carbohydrates, lipids, and nucleic acids; enzymology; metabolism; biosynthesis; and selected topics. Not acceptable for credit toward a major in biochemistry or biophysics.

BBMB 311. Biochemistry Laboratory. (1-3) Cr. 2. F.S. *Prereq:* Credit or enrollment in 301 or Biol 302. Emphasis on isolation, characterization, and quantification of biological substances. Not acceptable for credit toward a major in biochemistry or biophysics. Materials fee.

BBMB 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of the department cooperative education coordinator; junior classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

BBMB 404. Biochemistry. (3-0) Cr. 3. F. *Prereq:* Chem 332. A general overview for graduate and advanced undergraduate students in agricultural, biological, chemical and nutritional sciences. Chemistry of amino acids, proteins, carbohydrates, and lipids, vitamins; protein structure; enzymology; carbohydrate metabolism. Credit for both 420 and the 404, 405 sequence may not be applied toward graduation. Nonmajor graduate credit.

BBMB 405. Biochemistry. (3-0) Cr. 3. S. *Prereq:* 404. A general overview for graduate and advanced undergraduate students in agricultural, biological, chemical, and nutritional sciences. Metabolism of amino acids nucleotides and lipids; formation, turnover, and molecular relationships among DNA, RNA, and proteins; genetic code; regulation of gene expression; selected topics in the molecular physiology of plants and animals. Credit for both 420 and the 404, 405 sequence may not be applied toward graduation. Nonmajor graduate credit.

BBMB 411. General Biochemical Research Techniques. (1-8) Cr. 3. F. *Prereq:* Credit or enrollment in 404 or 501, Chem 210 or 211. Introduction to laboratory techniques for studying biochemistry, including: chromatographic methods; electrophore-

sis; spectrophotometry; enzyme purification; enzyme kinetics; and characterization of carbohydrates, proteins, lipids, and nucleic acids. Materials fee. Nonmajor graduate credit.

BBMB 420. Physiological Chemistry. (3-0) Cr. 3. F. *Prereq:* Chem 332, BBMB 301 or Biol 302. Structure and function of proteins; enzymology; biological oxidation; chemistry and metabolism of carbohydrates, lipids, amino acids and nucleic acids; protein synthesis and the genetic code; relationship of biochemistry to selected animal diseases. Biochemistry of higher animals emphasized. Not acceptable for credit toward a major in agricultural biochemistry, biochemistry or biophysics. Credit for both 420 and the 404, 405 sequence may not be applied toward graduation. Nonmajor graduate credit.

BBMB 451. Physical Biochemistry. (2-0) Cr. 2. F. *Prereq:* Chem 331, Phys 112 or 222; a previous course in calculus is helpful but not required. Selected topics in physical chemistry in the context of applications to problems in biology, biochemistry and food sciences. Not acceptable for credit toward a major in biochemistry or biophysics. Nonmajor graduate credit.

BBMB 461. Topics in Biophysics. (2-0) Cr. 2. S. *Prereq:* 451 or Chem 321 or Phys 304. Biological phenomena viewed as problems in physics. Survey of selected topics such as bioenergetics, muscle contraction, nerve conduction, vision, and macromolecular behavior. Nonmajor graduate credit.

BBMB 490. Independent Study. F.S.SS. Cr. arr. *Prereq:* College of Agriculture; junior or senior classification and permission of instructor; a maximum of 9 credits of 490 may be applied toward graduation; College of Liberal Arts and Sciences; permission of instructor; no more than 9 credits of BBMB 490 may be counted toward graduation.

BBMB 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of the department cooperative education coordinator; senior classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

BBMB 499. Undergraduate Research. F.S.SS. Cr. 1 to 5. *Prereq:* Permission of staff member with whom student proposes to work. Research under senior staff guidance.

Courses Primarily for Graduate Students, open to qualified undergraduate students

BBMB 501. Comprehensive Biochemistry. (4-0) Cr. 4. F. *Prereq:* Chem 210 or 211, 322, and 332; a previous course in biochemistry is strongly recommended. Chemical composition of living matter and the chemistry of life processes. Chemical characterization of amino acids, proteins, carbohydrates, lipids, and nucleotides; enzymology and co-enzymes; metabolism of carbohydrates; biological oxidations.

BBMB 502. Comprehensive Biochemistry. (4-0) Cr. 4. S. *Prereq:* 501. Chemical composition of living matter and the chemistry of life processes. Metabolism of lipids, amino acids, and nucleotides; membrane biochemistry; biosynthesis of DNA, RNA, and proteins; gene regulation; selected topics.

BBMB 503. Bioinorganic Chemistry. (Same as Chem 503.) See *Chemistry*.

BBMB 511. Topics in Experimental Biochemistry. (1-6) Cr. 1 each time taken. F.S. *Prereq:* Credit or enrollment in 404 or 501, Chem 210L or 211L. Taught as individual one-credit modules. Materials fee. Modules include:
A. Protein Chemistry
B. Radiosotopes in biochemistry
C. Flow cytometry
D. Monoclonal antibodies
E. Special techniques

BBMB 520. Genetic Engineering. (Same as Gen 520.) See *Genetics*.

BBMB 531. Structure and Reactivity of Biomolecules. (3-0) Cr. 1. F. Five weeks. *Prereq:* Chem 332. Special properties of reactive groups prevalent in biomolecules and reactions commonly

encountered in biochemical studies. A study of reaction types and mechanisms in biochemistry.

BBMB 540. Signal Transduction. (Same as Zool 540.) See *Zoology*.

BBMB 541. Computational Biochemistry. (1-0) Cr. 1. F. *Prereq:* A previous course in biochemistry is recommended. Computer applications in biochemical research.

BBMB 542. Introduction to Molecular Biology Techniques. (Same as Zool 542.) See *Zoology and Genetics*.

BBMB 551. Molecular Biophysics. (3-0) Cr. 3. F. *Prereq:* Chem 322. An examination of physical methods for the study of the molecular structure and organization of biological materials, with emphasis on applications. Spectroscopy, hydrodynamic methods, and X-ray diffraction.

BBMB 581. Seminar. (1-0) Cr. 1. F. *Prereq:* Permission of instructor. Short presentations by students and discussion on assigned topics. For entering graduate students.

BBMB 590. Special Topics. F.S.SS. Cr. arr.

BBMB 593. Workshop in Biochemistry and Biophysics. Cr. 1 each time taken. *Prereq:* Permission of instructor. Graduate workshops in selected topics in biochemistry and biophysics. Credit in this course does not meet the requirement for advanced graduate electives in Biochemistry.

Courses for Graduate Students

BBMB 607. Plant Biochemistry. (2-0) Cr. 2. Alt. S., offered 2001. Thornburg, Nikolau. *Prereq:* 405 or 502. Description of unique aspects of plant biochemistry including lipid metabolism, cell wall structure, secondary metabolism, phytoalexin biosynthesis, and plant defenses.

BBMB 615. Molecular Immunology. (Same as Gen 615, Micro 615.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 405 or 502. Buss. Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; intracellular signalling pathways leading to expression of genes that control and activate immune function.

BBMB 622. Carbohydrate Chemistry. (2-0) Cr. 2. Alt. S., offered 2000. Robyt. *Prereq:* 404 or 501. Structure, occurrence, properties, function, and chemical and enzymatic modifications of monosaccharides, oligosaccharides, polysaccharides, and glycoproteins.

BBMB 632. Kinetics of Enzyme Action. (2-0) Cr. 1 or 2. 8 or 16 weeks. Alt. S., offered 2001. Fromm. *Prereq:* 501. The one-credit version stresses the fundamentals of enzyme kinetics. Topics include integrated rate equations, methods for deriving initial-rate equations, inhibition, product effects, and methods for verifying kinetic mechanisms. The two-credit version covers the same material plus additional topics such as allostery, hysteresis, isotope effects, and complex kinetic mechanisms.

BBMB 642. Mechanisms of Enzymatic Catalysis. (2-0) Cr. 1. First 8 weeks. Alt. F., offered 1999. Robyt. *Prereq:* 404, 420, or 501. The chemical basis of enzymatic catalysis with emphasis on mechanisms of substrate recognition, general acid-base catalysis and stereoelectronic factors.

BBMB 645. Molecular Endocrinology: Hormones and Growth Factors. (3-0) Cr. 2. Alt. S., offered 2001. Nilsen-Hamilton. *Prereq:* 405, 420, or 502. The endocrine system and mechanism of hormone and growth factor action with emphasis on receptors and signal transduction.

BBMB 652. Protein Chemistry—Chemical Methods. (2-0) Cr. 1. 8 weeks. Alt. S., offered 2000. Graves. *Prereq:* 404 or 501. Chemical reactions as a means of determining protein structure and biological function.

BBMB 653. Protein Chemistry—Physical Methods. (2-0) Cr. 1. 8 weeks. Alt. S., offered 2000. Staff. *Prereq:* 404 or 501; 541 or familiarity with UNIX operating systems. Application of physical methods to protein structure and biological function.

BBMB 660. Membrane Biochemistry. (2-0) Cr. 2. Alt. F., offered 1999. Chitinis. *Prereq:* 405 or 502. Protein and lipid constituents of biological membranes. Structure and topography of membrane proteins. Selected topics concerning the membrane proteins involved in diverse biochemical processes, such as energy transduction transport across membranes, neurotransmission and signal transduction.

BBMB 670. Molecular Biology of Muscle. (Same as An S 670.) (3-0) Cr. 3. Alt. F., offered 2000. Huiatt, Robson, Stromer. *Prereq:* 405, 420, or 502. Ultrastructure of muscle; chemistry, structure, function, and molecular biology of muscle proteins. Molecular aspects of muscle contraction, development, and turnover. Cytoskeletal proteins and dynamics.

BBMB 675. Nucleic Acid Structure and Function. (Same as Gen 675.) (2-0) Cr. 2. Alt. F., offered 2000. *Prereq:* 405 or 502. Properties of nucleic acids; relationship of nucleic acid structure to function. Chemistry of nucleotides; the chemical reactivity of nucleic acids; analytical and separation methods; nucleases; sequence determination; synthesis of specific genes; nucleoproteins.

BBMB 676. Biochemistry of Gene Expression in Eucaryotes. (Same as MCDB 676.) (2-0) Cr. 2. Alt. S., offered 2000. *Prereq:* 404 or 501, 405 or 502 or Gen 511. Staff. Analysis of the biochemical processes involved in expression of eucaryotic genes and the regulation thereof, including RNA polymerase, transcriptional regulatory proteins, enhancers and silencers, chromosome structure, termination, RNA processing, RNA transport, RNA turnover, translational regulation, protein turnover.

BBMB 681. Advanced Seminar. Cr. 1 each time taken. F.S. *Prereq:* Permission of instructor. Student presentations.

BBMB 682. Departmental Seminar. Cr. R. F.S. *Prereq:* Permission of instructor. Staff and visitor presentations.

BBMB 696. Seminar in Plant Physiology and Molecular Biology. (Same as Bot 696.) See *Botany*.

BBMB 698. Seminar in Molecular, Cellular, and Developmental Biology. (Same as MCDB 698.) See *Molecular, Cellular, and Developmental Biology*.

BBMB 699. Research. *Prereq:* Permission of instructor.

Biological/ Premedical Illustration

(Interdepartmental Undergraduate Program)

Program Committee: Warren D. Dolphin, Chair; Dean Biechler, C. Arthur Croyle, Steven M. Herrnstadt, Harry Horner.
Ex officio: Jean Lassila and Jennifer Owens

Undergraduate Study

The interdepartmental undergraduate BPM I major is designed for students who want to combine their interests and aptitudes in science and art. Based on the concept of "communicating science through art," the major prepares students for careers in biological illustration or for graduate education in medical illustration elsewhere. Graduates enter fields such as biocommunications, environmental display design, free-lance illustration, museum display design, and various careers in the publishing industry.

Entrance into the BPM I program is by application to the BPM I Advisory Committee.

Eligibility is based on an academic standard of at least 2.00 CGPA on 30 credits of university level work and a consideration of artistic ability as demonstrated through submission of a portfolio of representative drawings or other art work. Freshman and transfer students usually declare pre-BPM I as their major while satisfying the conditions for entrance into the major, although other majors can be declared.

To earn the B.A. degree offered by the College of Liberal Arts and Sciences, students must complete the general education requirements in that college and take at least 42 credits in design and 32 credits in the biological sciences. Design courses include: Art 130 and 230, ArtDP 233, 238, and 330, BPM I 326, 327, 336, 337, and 497, and JI MC 310 or ArtVS 229, plus 12 credits chosen from a list of approved upper level courses in art and design. Biological science courses include: Biol 102, 201, 201L, 202, 202L; Bot 306 or 404 or 505; Zool 155, 320, and at least 12 credits chosen from a list of approved biological science courses. Students must earn a grade of C- or better in all art and science courses included in the major and must earn an overall GPA of 2.00 in both categories. A brochure is available in 201 Bessey Hall that gives a detailed listing of the requirements. Additional information is also available on the WWW. Connect to <http://www.biology.ias-tate.edu>. Click on Biological Illustration.

English Proficiency Requirement. Students must earn a minimum of C in both English 104 and 105 or equivalent composition courses and in one advanced writing course numbered Engl 302 through 316, excluding 310.

Students in BPM I must complete a senior project or an internship experience in which they design and produce artwork that is suitable for publication or public display.

A minor in biological illustration is offered. A minimum of 17 credits must be taken, including 8 credits in biological science courses and 9 credits in art and design courses. The biological sciences must include Biol 201, 201L, 202, 202L. The art and design courses must include ArtVS 336 and 337, and an advanced drawing or painting course. For more information, contact the chair of the BPM I Advisory Committee in 201 Bessey Hall.

Courses Primarily for Undergraduate Students

BPM I 326. Introduction to Illustration. (Same as ArtVS 326.) See *Art and Design, Visual Studies*.

BPM I 327. Illustration as Communication and Interpretive Expression. (Same as ArtVS 327.) See *Art and Design, Visual Studies*.

BPM I 336. Biological Illustration Principles and Techniques. (Same as ArtVS 336.) (0-6) Cr. 3 each time taken, maximum of 6. F. *Prereq:* 6 credits in art and design and 3 credits in biological sciences. Studio basics and fundamentals of traditional biological rendering techniques. Emphasis on tools and materials.

BPM I 337. Application of Biological Illustration Techniques. (Same as ArtVS 337.) (0-6) Cr. 3 each time taken, maximum of 6. S. *Prereq:* 336. Rendering techniques applied to different types of biological subject matter including computer applications. Term project required.

BPM I 398. Cooperative Education. Cr. R. F.S.S.S. *Prereq:* Permission of the program cooperative education coordinator, junior classification. Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

BPM I 490. Independent Study. Cr. 1 to 3 each time taken, maximum of 3. *Prereq:* Written approval of instructor and advisory committee chair on required form in advance of semester of enrollment. Offered on a satisfactory-fail grading basis only.

BPM I 494. Special Topics in Illustration. Cr. 1 to 3 each time taken. Intensive exploration of illustration techniques in a studio or field setting.

BPM I 497. Illustration Internship. Cr. 1 to 6 each time taken, maximum of 6. *Prereq:* Junior or senior classification in BPMI, written approval of supervising instructor and advisory committee chair on required form in advance of semester of enrollment. Offered on a satisfactory-fail grading basis only.

Biology

Warren D. Dolphin, Program Coordinator

The biological sciences at Iowa State University are organized into 20 departments and programs. These can be grouped into the basic sciences, agricultural sciences, and veterinary sciences. Well over 200 faculty consider themselves life scientists and most teach courses at the undergraduate and graduate levels. Such a large faculty group provides many opportunities for students to learn from some of the national leaders in biological research and teaching and to participate in exciting, meaningful research projects that explore the frontiers in the life sciences. Few other universities have such a wealth of faculty expertise available to undergraduate students.

Biology is an interdepartmental undergraduate major. Students majoring in Biology are able to integrate knowledge from several life science disciplines into a coherent, broadly based undergraduate program of study. Students who wish to study specific areas of the basic biological sciences should declare majors in animal ecology, biochemistry, botany, entomology, genetics, microbiology, or zoology. Although requirements for biology and related majors differ significantly, the courses taken during the first two years are similar. In particular, all require freshman biology and chemistry, most require calculus and organic chemistry, and all require credits in general education courses. As a result and with proper planning, a student is able to transfer from one basic biological science major to another without serious difficulty any time during the first two years. For detailed requirements, see the catalog entries under the particular majors.

The biology major is well suited for those who plan to teach biology, who wish to enter government or industrial employment in the health or environmental professions, or who prefer educational breadth as an end in itself. A bachelor's degree in biology provides excellent preparation for graduate study in many biological disciplines and for entrance into various professional schools, such as human medicine, physical therapy, or veterinary medicine. Students with particular interests can combine biology with a second major in another

er area, such as environmental studies, a foreign language, journalism, or any other major offered by the university.

Undergraduate Study

Of the courses taught by the biology program, Biol 109 is a general presentation of selected biological topics designed primarily for students not majoring in the basic biological sciences. Biol 123, also designed for the non-major, is intended to be an introduction to topics in environmental biology.

A unified biology core serves the various majors in the life sciences. This core consists of six integrated courses with labs that explore the basic principles of the biological sciences. The first year (Biol 201, 202) provides a broad introduction to the nature of life. The second year (Biol 301, 302) provides an integrated foundation in the principles of genetics, cell biology, and elementary biochemistry. The third year (Biol 312, 303) provides an ecological and evolutionary perspective.

A detailed description of the courses required in the biology major is available in 201 Bessey Hall or is available on the WWW at <http://www.biology.iastate.edu>. Biology majors take a minimum of 40 credits in the biological sciences, including the following courses: Biol 102, 201, 201L, 202, 202L, 301, 301L, 302, 302L, 303, and 312 plus 18 additional credits in approved life science courses numbered 300 or above. These advanced courses are taught by faculty in the biological science departments previously listed. Courses beyond the core must be chosen from at least two departments so that the student's program of study reflects breadth of preparation. Students are encouraged to participate in research projects by taking Biol 490 (Independent Study) in order to gain research experience prior to graduation. A maximum of 6 credits in Biol 490 may be applied toward the advanced course requirement. A grade of C- or better is required in all biological science courses applied to the major and the cumulative average in the major must be at least a C.

Supporting course requirements include: 16 credits in chemistry to include two semesters of general chemistry with labs and at least one semester of organic chemistry with lab; after demonstrating competence in algebra and trigonometry, two semesters of calculus or two semesters of statistics chosen from a list of approved courses available in 201 Bessey Hall; and a two-semester sequence in general physics.

Because biology is a major in the College of Liberal Arts and Sciences, students must fulfill the foreign language and general education requirements in that college.

English Proficiency Requirement. Students must earn a minimum of C in both English 104 and 105 or equivalent composition courses and in one advanced writing course numbered Engl 302 through 316, excluding 310.

In addition to courses offered on campus, courses in field and aquatic biology are offered at the Iowa Lakeside Laboratory. Courses in

marine biology are available at the Gulf Coast Research Laboratory in Mississippi.

Biology majors seeking certification to teach biology in secondary schools must meet requirements of the College of Education as well as those of the biology program. In addition they must apply formally for admission to the teacher education program. See *Index, Teacher Education Program, Teacher Licensure*.

The program offers a minor in biology which may be earned by credit in Biol 201, 201L, 202, 202L, 301, and 6 credits in courses numbered 300 or above from a list available in the Biology Office. A minor or a double major in biology with a major in Animal Ecology, Agricultural Biochemistry, Biochemistry, Biochemistry, Botany, Entomology, Genetics, Microbiology, or Zoology is not permitted. Likewise, a minor in another basic biological science with a major in biology is not permitted.

Graduate Study

Biology is only an undergraduate major. Persons interested in graduate study in the biological sciences should apply directly to one of the life science departments. Interdepartmental graduate offerings in ecology and evolutionary biology (EEB); genetics; molecular, cellular, and developmental biology (MCDB); neurobiology; plant physiology; toxicology; immunobiology; biomedical engineering; and water resources are also available. (See *Index*.)

A non-thesis master's degree in interdisciplinary graduate studies (biological sciences) has been established particularly for teachers who wish to broaden and update their formal training in biology.

Courses open for nonmajor graduate credit: 403I.

Courses Primarily for Undergraduate Students

Biol 102. Opportunities in Biology. (1-0) Cr. .5. F. Orientation to the scope of the biological sciences, and discussion of professional opportunities. Required of first year biology majors.

Biol 109. Introductory Biology. (3-0) Cr. 3. F.S.SS. Life considered at cellular, organism, and population levels. Function and diversity of the living world. Presentation of basic biological principles as well as topics and issues of current human interest. Non-majors only. Students may receive graduation credit for no more than one of the following: 109, 201.

Biol 123. Environmental Biology. (Same as Env S 123.) (3-0) Cr. 3. F.S. An introduction to the structure and function of natural systems at scales from the individual to the biosphere and the complex interactions between humans and their environment. Discussions of human population growth, biodiversity, sustainability, resource use, and pollution. Does not count toward credits required in Biology major.

Biol 201. Principles of Biology I. (3-0) Cr. 3. F.S. *Prereq:* High school biology and chemistry or credit or enrollment in Chem 163 or 177. Introduction to the nature of life, including the cellular basis of life; the nature of heredity; evolution; diversity of microbial, plant, and animal life; and principles of ecology.

Biol 201L. Principles of Biology Laboratory. (0-3) Cr. 1. F.S. *Prereq:* Credit or enrollment in 201. Laboratory to accompany 201. Materials fee.

Biol 202. Principles of Biology II. (3-0) Cr. 3. F.S. *Prereq:* 201. Introduction to the nature of life, includ-

ing the cellular basis of life; energy relationships; the nature of heredity; evolution; form and function of microbial, plant, and animal life.

Biol 202L. Principles of Biology Laboratory. (0-3) Cr. 1. F.S. *Prereq:* credit or enrollment in 202. Laboratory to accompany 202. Materials fee.

Biol 298. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Sophomore classification and permission of the department cooperative education coordinator. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Biol 301. Principles of Genetics. (Same as Gen 301.) (3-0) Cr. 3. F.S. *Prereq:* 201L and 202 L, credit or enrollment in organic chemistry. Introduction to the principles of transmission and molecular genetics of plants, animals, and bacteria. Recombination, structure and replication of DNA, gene expression, cloning, quantitative and population genetics. Students may receive graduation credit for no more than one of the following: 301 and 301L, Gen 260, Gen 301, Gen 320, and Agron 320.

Biol 301L. Genetics Laboratory. (Same as Gen 301L.) (0-3) Cr. 1. F.S. *Prereq:* Credit or enrollment in 301. Laboratory to accompany 301. Materials fee. Students may receive graduation credit for no more than one of the following: 301 and 301L, Gen 260, Gen 301, Gen 320, and Agron 320.

Biol 302. Principles of Molecular Cell Biology and Biochemistry. (3-0) Cr. 3. F.S. *Prereq:* 301. Integration of elementary principles of metabolism, bioenergetics, cell structure and function to develop a molecular view of how the cell works.

Biol 302L. Molecular Cell Biology and Biochemistry Laboratory. (0-3) Cr. 1. F.S. *Prereq:* Credit or enrollment in 302. Laboratory to accompany 302. Materials fee.

Biol 303. Biological Evolution. (Same as Bot 303, Zool 303.) (3-0) Cr. 3. F.S. *Prereq:* Credit or enrollment in 301. The mechanisms of evolution. Topics in microevolution: population genetics, natural selection, genetic variation, and adaptation. Macroevolution: speciation, extinction, phylogeny, and major evolutionary patterns.

Biol 312. Ecology. (Same as A Ecl 312, Bot 312.) (2-3) Cr. 3. F.SS. *Prereq:* 201L and 202L. Fundamental concepts and principles of ecology dealing with organisms, populations, communities and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats. Materials fee.

Biol 312I. Ecology. (Same as Ia LL 312I.) See *Iowa Lakeside Laboratory*.

Biol 374. Insects and Our Health. (Same as Ent 374.) See *Entomology*. Nonmajor graduate credit.

Biol 394. International Field Trips in Biology. Cr. 1 to 4 each time taken. *Prereq:* Two courses in the biological sciences and by approval of application. Extended field trips, usually during break periods, to international locations of interest to biologists. Inquire in 201 Bessey Hall for trip schedule.

A. Pre-trip Seminar. Cr. 1. Discussion of relevant biological and cultural topics during semester preceding trip.

B. Field trip. Cr. 1 to 3. Trip to international location under supervision of faculty member. Report required. Field trip fee.

Biol 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Junior classification and permission of the department cooperative education coordinator. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Biol 403I. Evolution. (Same as Ia LL 403I.) See *Iowa Lakeside Laboratory*. Nonmajor graduate credit.

Biol 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* 8 credits in biology and permission of instructor. See also 490 offerings in biological science departments. No more than 9 credits in Biol 490 may be counted toward graduation.

I. Iowa Lakeside Laboratory

U. Laboratory teaching experience. Cr. 1 to 2. For

students registering to be undergraduate laboratory assistants. Offered on a satisfactory-fail grading basis only.

R. Biological research. Cr. 1 to 5 each time taken. For students registering to work on an independent research project under the direction of a faculty member.

Biol 495. Undergraduate Seminar. Cr. 1. F. *Prereq:* 15 credits in biological science. Current issues in biology investigated. Graduate school and employment opportunities discussed. Practice given in résumé writing and interview techniques.

Biol 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Senior classification and permission of the department cooperative education coordinator. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Offered at the Gulf Coast Research Laboratory (GCRL), Ocean Springs, Mississippi

The Gulf Coast Research Laboratory is affiliated with the University of Southern Mississippi. Iowa State students may register for the following University of Southern Mississippi courses and transfer them to their ISU degree programs. Written permission of the ISU coordinator for the GCRL, 201 Bessey, is required for this arrangement. Inquire at 201 Bessey for further information..

MAR 301. Marine Biology. Cr. 3. SS. *Prereq:* 8 semester hours of biological sciences. A general introduction to marine biology with emphasis on local fauna and flora.

MAR 301L. Marine Biology Lab. Cr. 2. SS. Lab to accompany 301.

MAR 457. Marine Science for Teachers. Cr. 2 or 4. SS. *Prereq:* Permission of instructor. Designed to acquaint teachers with marine and coastal environments.

MAR 457L. Marine Science for Teachers Lab. Cr. 1 or 2. Lab to accompany 457.

Other courses offered at Gulf Coast are listed under Animal Ecology: Botany; Geological and Atmospheric Sciences, Microbiology, Immunology, and Preventive Medicine; and Zoology and Genetics.

Biomedical Engineering

(Interdepartmental Graduate Program)

Supervisory Committee: M. H. Greer, associate professor in charge; E. B. Bartlett, T. R. Derrick, R. L. Engen, A. B. Flateau, W. D. Franke, R. T. Greer, C. A. Heath, S. Jeftinija, S. Mallapragada, T. D. McGee, S. P. McLean, P. E. Patterson, R. C. Seagrave, H. Tyler, R. J. Weber, H. Xin

The biomedical engineering program (B M E) is interdisciplinary in scope. The participating faculty are from the Colleges of Engineering, Veterinary Medicine, Education and Agriculture. Biomedical engineers are concerned with the application of engineering concepts and analytical techniques to biological and medical problems. They are interested in developing new concepts, instrumentation, and materials for use with living systems. In addition, they seek to understand those phenomena of living systems which have functional capabilities desirable in the design of

physical systems. Graduates of the program are able to understand scientific literature, formulate hypotheses, complete independent research or design projects and report their results. They engage in research or design careers in the various fields of biomedical engineering.

Undergraduate Study

A curriculum leading to a bachelor's degree in biomedical engineering is not offered.

Undergraduate students planning graduate study are encouraged to develop knowledge in subjects prerequisite to biomedical engineering courses. For example, undergraduate students majoring in engineering, physics, or mathematics are encouraged to elect courses in organic chemistry, biochemistry, and biology. Undergraduate students majoring in life science areas should prepare for graduate study by electing courses in mathematics, engineering, and physics.

Graduate Study

Work is offered for the degrees master of science and doctor of philosophy with a major in biomedical engineering; students taking major work in other areas can minor or comajor in biomedical engineering. Prerequisite to major and minor work in biomedical engineering is an undergraduate degree in one of the fields of engineering, life sciences, physical sciences, or a professional degree in one of the fields of medicine.

The program of formal courses taken by students is oriented toward developing proficiency in research or design in the interdisciplinary field or in utilizing biomedical principles in clinical situations. Selected background and advanced courses from related disciplines are taken in conjunction with appropriate biomedical engineering courses. The program of formal courses varies, depending upon the background and interests of the student, and is determined in consultation with the student's advisory committee.

Course Primarily for Undergraduate Students

B M E 401. Scope of Biomedical Engineering. (1-0) Cr. 0.5. F. 8 weeks. Topics characteristic of career activities in biomedical engineering. For undergraduate students who wish to become familiar with the field of biomedical engineering. Offered on a satisfactory-fail grading basis only.

Courses Primarily for Graduate Students, open to qualified undergraduate students

B M E 521. Biomechanics. (Same as E M 521, I E 521.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* Phys 111 or 221, Math 265. For students with interests in the life sciences, ergonomics, or rehabilitation engineering. Topics include equilibrium, motion, energy, stress and deformation, material properties, flow of fluids, dimensional analysis and modeling of biological systems. Illustrative examples taken from biology and medicine.

B M E 540. Biomedical Applications of Chemical Engineering. (Same as Ch E 540.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* Ch E 210, Math 266, Phys 222. Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomechanical and bio

chemical engineering, applied physiology and environmental studies.

B M E 549. Advanced Vertebrate Physiology I. (Same as BMS 549.) See *Biomedical Sciences*.

B M E 552. Advanced Vertebrate Physiology II. (Same as BMS 552.) See *Biomedical Sciences*.

B M E 555. Biomedical Fluid Mechanics. (Same as E M 555.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 521. Application of principles and concepts of fluid mechanics to problems in biology and medicine. Hemodynamic characteristics of the circulation, rheology of blood, flow in the microcirculation, flow in the large arteries, and the respiratory system.

B M E 580. Biomaterials. (Same as E M 580, M S E 580.) (3-0) Cr. 3. S. *Prereq:* Mat E 271. Presentation of the basic chemical and physical properties of biomaterials as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

B M E 590. Special Topics. Cr. 1 to 5 as arranged. Investigation of problems of special interest in biomedical engineering.

- A. Instrumentation
- B. Simulation
- C. Transport Phenomena
- D. Biomaterials
- E. Information Processing
- F. Tissue Engineering
- G. Biomechanics
- H. Virtual Reality
- I. Computational Intelligence

Courses for Graduate Students

B M E 690. Advanced Topics. Cr. 1 to 5 as arranged.

- A. Instrumentation
- B. Simulation
- C. Transport Phenomena
- D. Biomaterials
- E. Information Processing
- F. Tissue Engineering
- G. Biomechanics
- H. Virtual Reality
- I. Computational Intelligence

B M E 699. Research.

Biomedical Sciences

*Richard J. Martin, Chair of Department
University Professor: Adams*

University Professor (Emeritus): Reece

*Distinguished Professors (Emeritus):
Christensen, Dellmann,*

*Professors: Ahrens, Cheville, Draper, Dyer,
Engen, Evans, Ghoshal, Hsu, Martin, Pineda,
Randic, Riedesel, Taylor, Uemura, VanMeter*

Professors (Collaborators): Horst, Whipp

*Professors (Emeritus): Bal, Carithers,
Hembrough, Swenson*

*Associate Professors: Greer, Jeftinija, Martin,
Sharp, Ware*

Associate Professor (Emeritus): Crump

Associate Professor (Collaborator): Goff

Assistant Professor: Apley

Assistant Professor (Adjunct): Sonea

*Assistant Professor (Collaborator):
Rasmussen*

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see *Veterinary Medicine, Curriculum*.

A thorough knowledge of anatomy and physiology of domestic animals is necessary to understand the mechanisms and the treatment of animal diseases. The study of comparative mammalian physiology gives students a background in the functional activities of cells, tissues, organs, and systems with special consideration for the basic physiology of importance to veterinary medicine.

An understanding of drug action is essential for rational drug therapy. The general pharmacology courses provide students with a background in basic pharmacology to include pharmacodynamics, toxicology, and the clinical application of drugs. Special emphasis is placed on chemical agents and therapeutic practices specific to veterinary medicine.

Graduate Programs

The department offers work for the degrees master of science and doctor of philosophy with majors in veterinary anatomy, physiology or in physiology with pharmacology as a specialization. In veterinary anatomy, both thesis and nonthesis options are available for the master of science degree. Up to 10 credits of dual-listed veterinary anatomy courses may be applied for major graduate credit. Departmental research facilities provide for training in experimental anatomy, pharmacology, and physiology. Graduate studies are supervised by faculty members recognized in their areas of expertise. Current areas of research include: diabetes mellitus, endocrine physiology, gastrointestinal pharmacology, glia-neuron signaling, neurophysiology of pain, neurotoxicology and pulmonary physiology. The objective of the department is to prepare graduate students for successful careers in research and professional service. The department is part of interdepartmental programs in neuroscience, toxicology, and molecular, cellular, and developmental biology. Cooperative programs between Biomedical Sciences and the Biomedical Engineering Program are provided jointly by the Colleges of Engineering and Veterinary Medicine. The combined Ph.D./DVM program is an option.

Foreign language requirements may be established by the student's program of study committee.

Courses open for nonmajor graduate credit: 354, 401, 402, 421.

Courses Primarily for Undergraduate Students

BMS 329. Physiology of Domestic Animals. (3-3) Cr. 4. F.S. Prereq: *Biol 202, 202L*. Survey of body system functions and their correlations, with emphasis on the domestic animals. Includes appropriate anatomy. Provides a medical science orientation and has particular usefulness for students in preveterinary medicine and others where this foundation would be helpful to their major.

BMS 330. Principles of Morphology I. (Dual-listed with 530.) (3-6) Cr. 5. F. Prereq: *First-year classification in veterinary medicine*. Comparative anatomy of domestic animals.

BMS 331. Principles of Morphology II. (Dual-listed with 531.) (2-6) Cr. 4. S. Prereq: *First-year classification in veterinary medicine*. Comparative and applied anatomy of domestic animals.

BMS 332. Microscopic Anatomy. (Dual-listed with 532.) (3-3) Cr. 4. F. Prereq: *First-year classification in veterinary medicine*. Cytology, histology and organology of domestic animals.

BMS 337. Neurobiology. (Dual-listed with 537.) (2-3) Cr. 3. S. Prereq: *First-year classification in veterinary medicine*. Neurobiology of domestic animals.

BMS 338. Pharmacology I: Fundamental Principles. (Same as Zool 338.) (2-0) Cr. 2. F. Prereq: *Biol 302, Chem 177, 177L, 178, 178L, 231, Stat 104*. Pharmacology as a science. Fundamental concepts of how drugs are taken up, distributed and eliminated by the body, and mechanisms of drug action. The course is not accepted for credit towards the DVM degree.

BMS 339. Pharmacology II: The Biological Systems. (Same as Zool 339.) (3-0) Cr. 3. S. Prereq: *Biol 302, Chem 177, 177L, 178, 178L, 231, Stat 104*. Basic pharmacology of drugs that act on the human biological systems. This course is not accepted for DVM degree credit.

BMS 345. Case Study I. (0-4) Cr. 2. F. Prereq: *First-year classification in veterinary medicine*. Clinical applications of basic sciences.

BMS 346. Case Study II. (0-2) Cr. 1. S. Prereq: *First-year classification in veterinary medicine*. Clinical applications of basic sciences.

BMS 349. Comparative Veterinary Physiology I. (3-0) Cr. 3. F. Prereq: *First-year classification in veterinary medicine*. Blood, body fluids, endocrinology, renal and gastrointestinal physiology of domestic animals.

BMS 350. Comparative Veterinary Physiology II. (4-3) Cr. 5. S. Prereq: *First-year classification in veterinary medicine*. Cardiovascular, respiratory, and reproductive physiology of domestic animals.

BMS 354. General Pharmacology. (Dual-listed with 554.) (3-0) Cr. 3. S. Prereq: 349, 350. General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems. Nonmajor graduate credit.

BMS 355. Integrative Physiology. (0-2) Cr. 1. F. Prereq: *Second-year classification in veterinary medicine*. To integrate all organ systems into a total physiological response to stress, etc. Small group discussions and computer simulations will be utilized.

BMS 401. Reproductive Management of the Dog and the Cat; Contraception and Contraceptives. (1-0) Cr. 1. S. Prereq: 350 or An S 331. Reproductive management and methods for the control of dog and cat populations. Social, economical, and ecological aspects of controlling pet populations are emphasized. Nonmajor graduate credit.

BMS 402. The Physiology of Gastrointestinal Disturbances. (2-0) Cr. 1. F. Second 8 weeks. Prereq: 350. Ahrens, Goff. Gastrointestinal abnormalities associated with motility, secretion, absorption, and digestion with emphasis on neonatal animals such as the puppy, pig, and calf. Nonmajor graduate credit.

BMS 403. Behavior of Domestic Animals. (1-0) Cr. 1. Alt. S., offered 2000. Prereq: *Classification in veterinary medicine*. Normal and abnormal behavior of domestic animals.

BMS 415. Anatomy of Laboratory Animals. (Dual-listed with 515.) (1-2) Cr. 2. Alt. S., offered 2000. Prereq: *One year of college biology*. Gross and microscopic anatomy of laboratory animals.

BMS 416. Avian Anatomy. (Dual-listed with 516.) (1-2) Cr. 2. Alt. S., offered 2001. Prereq: *One year college biology*. Gross and microscopic anatomy of domestic and exotic birds.

BMS 421. Special and Applied Anatomy of the Horse. (1-3) Cr. 2. F. Prereq: 330, *classification in veterinary medicine or An S 316 or 415*. Applied anatomy of the horse. Nonmajor graduate credit.

BMS 443. Pharmacology and Therapeutics. (Dual-listed with 543.) (3-0) Cr. 3. F. Prereq: 354. Pharmacology and therapeutic uses of fluids, antimicrobial drugs and antiparasitic drugs and adverse drug reactions.

BMS 490. Independent Study. Cr. 1 to 5 each time taken. Prereq: *Permission of instructor*. H. Honors

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

BMS 501. Selected Research Methods in Pharmacology. (0-8) Cr. 3. F.S.SS. Prereq: *Graduate classification, permission of pharmacology staff*. Experience in pharmacologic techniques in selected pharmacology laboratories: cytochemical methods, extracellular and intracellular unit recording, microiontophoresis, spectrophotofluorometric analysis of biogenic amines, atomic absorption spectrometry, radioimmunoassay, gas chromatography, enzyme analysis, use of isotopes in drug studies, intestinal perfusion techniques, renal clearance methods, and isolated tissue bioassay.

BMS 509. Systematic Anatomy. (2-6) Cr. 4. Alt. SS., offered 2000. Prereq: *One year of college biology and permission of instructor*. For non-anatomy majors.

A. Ruminant Anatomy.
B. Nonruminant Anatomy

BMS 511. Functional Neuroanatomy and Morphology of Neurotransmitter Pathways. (2-4) Cr. 4. Alt. F., offered 2000. Prereq: *10 credits in biological science and permission of instructor*. Basic organizational schemes of the mammalian brain including cytoarchitecture, chemoarchitecture, and connectivity of different regions of the nervous system.

BMS 515. Anatomy of Laboratory Animals. (Dual-listed with 415.) (1-2) Cr. 2. Alt. S., offered 2000. Prereq: *One year of college biology*. Gross and microscopic anatomy of laboratory animals.

BMS 516. Avian Anatomy. (Dual-listed with 416.) (1-2) Cr. 2. Alt. S., offered 2001. Prereq: *One year college biology*. Gross and microscopic anatomy of domestic and exotic birds.

BMS 530. Principles of Morphology I. (Dual-listed with 330.) (3-6) Cr. 5. F. Prereq: *10 credits in biological science and permission of the instructor*. Comparative anatomy of domestic animals.

BMS 531. Principles of Morphology II. (Dual-listed with 331.) (2-6) Cr. 4. S. Prereq: BMS 530. Comparative anatomy of domestic animals.

BMS 532. Microscopic Anatomy. (Dual-listed with 332.) (3-3) Cr. 4. F. Prereq: *10 credits in biological science and permission of the instructor*. Cytology, histology and organology of domestic animals.

BMS 537. Neurobiology. (Dual-listed with 337.) (2-3) Cr. 3. S. Prereq: *10 credits in biological science and permission of the instructor*. Neurobiology of domestic animals.

BMS 542. Introduction to Molecular Biology Techniques. (Same as Zool 542.) See *Zoology and Genetics*.

BMS 543. Pharmacology and Therapeutics. (Dual-listed with 443.) (3-0) Cr. 3. F. Prereq: 554. *Concurrent registration in BMS 544 is required for graduate students*. Pharmacology and therapeutic uses of fluids, antimicrobial drugs, antiparasitic drugs and selected drugs and adverse drug reactions.

BMS 544. Pharmacology and Therapeutics Literature Discussion. (1-0) Cr. 1. F. Prereq: *Concurrent registration in BMS 543*. Literature review and discussions and computer simulations related to BMS 543

BMS 549. Advanced Vertebrate Physiology I. (Same as An S 549, B M E 549.) (4-0) Cr. 4. F. Prereq: *Zool 355, credit or enrollment in BBMB 420 or 404*. Neurophysiology, sensory systems, muscle, neuroendocrinology, endocrinology.

BMS 552. Advanced Vertebrate Physiology II. (Same as B M E 552, Zool 552.) (4-3) Cr. 5. S. Prereq:

Zool 355; credit or enrollment in BBMB 420 or 404. Cardiovascular, renal, respiratory physiology, and digestion.

BMS 554. General Pharmacology. (Dual-listed with 354; Same as Tox 554.) (3-0) Cr. 3. S. Prereq: 549 and 552; BBMB 404, 405. Concurrent registration in BMS 555 is required for graduate students. General principles: drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems.

BMS 555. General Pharmacology Literature Discussion. (1-0) Cr. 1. S. Prereq: 549 and 552; BBMB 404, 405 and concurrent registration in BMS 554. Literature discussion and computer simulations related to BMS 554.

BMS 565. Physiology and Pharmacology of Autonomic Nervous System. (2-0) Cr. 2. Alt. S., offered 2001. Prereq: 549, 552 or permission of instructor. Hsu. Release of neurotransmitters and their regulation; control and regulation of autonomic functions; mechanisms of action of adrenergic and cholinergic receptors.

BMS 590. Special Topics. Cr. 1 to 7. Prereq: Permission of instructor.

- A. Anatomy
- B. Physiology
- C. Pharmacology

BMS 599. Creative Component. Cr. 1 to 3. Creative component for non-thesis master of science degree.

Courses for Graduate Students

BMS 630. Alimentary Physiology. (3-0) Cr. 3. Alt. S., offered 2000. Prereq: 552 or permission of instructor. Staff. A comparative study of ruminants and non-ruminants with emphasis on motility, secretion, digestion, and absorption.

BMS 631. Experimental Techniques in Physiology. (2-6) Cr. 4. Alt. SS., offered 2001. Prereq: 552 or permission of instructor; surgical skills not required but highly desirable. Staff. Course content: Surgical preparations and basic physiological studies of the cardiovascular, digestive, urogenital and other systems. Limited enrollment.

BMS 652. Respiratory Physiology. (2-1) Cr. 3. F. Prereq: 552. Independent study with computer programs reviewing normal and abnormal lung function. Review of current research literature on hemodynamics of respiratory system, lung mechanics, gas diffusion, surfactant, and related topics.

BMS 688. Research Review. Cr. 1 each time taken. F.S. A forum for BMS students to gain experience in the critical exchange of ideas through oral presentation and discussion of scientific information.

BMS 690. Advanced Topics. Cr. 1 to 5. Prereq: Permission of instructor.

- A. Anatomy
- B. Physiology
- C. Pharmacology

BMS 698. Seminar.

A. Cr. R each time taken. F.S.SS. Staff. Attendance required.

B. Cr. 1 each time taken. F.S.SS. Staff. Offered on a satisfactory-fail grading basis only. Attendance and presentation required.

BMS 699. Research.

- A. Anatomy
- B. Physiology
- C. Pharmacology

Botany

David J. Oliver, Chair of Department

Distinguished Professors: Tiffany

University Professors: Horner

Professors: Farrar, Knaphus, Oliver, van der Valk, Wendel

Distinguished Professors (Emeritus): Isely

Professors (Emeritus): Dodd, Lamotte, Lersten, Smith, Stewart, Swenson

Associate Professors: Clark, Colbert, Crumpton, Jurik, Moloney, Raich, Rodermel, Spalding, Wallace, Wurtele

Associate Professors (Collaborators): Bretting

Assistant Professors: Davies

Undergraduate Study

For undergraduate curriculum in liberal arts and sciences, major in botany, see *Liberal Arts and Sciences, Curriculum*.

The Botany department offers broad opportunity for the study of many basic and applied aspects of plant biology. The botany and biology majors and other undergraduate programs in which the department participates prepare students for a wide range of science-related occupations, including biotechnology, biology teaching, medicine and pharmacology, conservation and outdoor recreation activities, and research and development. The botany and biology majors offer excellent preparation for graduate study in biological sciences, or in such applied disciplines as agronomy, forestry, horticulture, and plant pathology. Graduates of the botany major understand the basic principles of plant structure, function, ecology, and evolution, and are able to communicate effectively about plant biology.

Botany is one of the basic biological sciences. Undergraduates majoring in Botany must therefore obtain a general biological foundation by taking courses in the biology program (see *Biology, Cross-Disciplinary Program*). Botany faculty are involved in both the organization and teaching of Biology courses, thus Biology and Botany are integrated for the benefit of the student.

In addition to the basic Liberal Arts and Sciences requirements, Botany majors must also complete:

1. Biol 201, 201L, 202, 202L, 301, 301L, 302, 302L, 303, and 312 (22 credits);
2. Bot 399 (seminar, 1 cr.) and 17 credits at the 300 level or above from an approved list, including courses from each of the major disciplines within Botany (18 credits);
3. Phys 111 and 112 (8 credits);
4. Two courses in Mathematics (calculus and/or statistics) from an approved list;
5. Two semesters of general chemistry with labs and at least one semester of organic chemistry with lab (13 credits);

English proficiency requirement: A grade of C or better in Engl 104 and 105; and a C or better in an approved writing course (or satisfactory performance on a departmental writing exam). A list of approved courses is available in 353 Bessey Hall.

The department recommends one or more courses in Zoology, Animal Ecology, or Microbiology. Qualified students are encouraged to enrich their program through an independent study or research project (Bot 490) under the guidance of a faculty member.

Courses at the Iowa Lakeside Laboratory, the Gulf Coast Research Laboratory, or other field laboratories are also recommended.

In addition to the courses listed above, students in consultation with their advisers choose electives that address their individual interests and needs.

A second major or minor in Biology with a major in Botany is not permitted.

Teacher Licensure: Botany majors seeking licensure to teach biology in secondary schools must meet requirements of the College of Liberal Arts and Sciences and the College of Education as well as those of the Botany major. In addition they must apply formally for admission to the Teacher Education Program. See *Index, Teacher Education Program, and Teacher Licensure*.

Botany Minor: The department offers a minor in Botany, which may be earned by completion of 15 or more credits in Botany courses with at least 6 credits in courses numbered 300 or above and earned at ISU with a grade of C or higher. The minor must include 9 credits that are not used to meet any other department, college or university requirement.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with a major in Botany, and minor work for students majoring in other departments. Within the Botany major one of the following areas of specialization may be designated: aquatic and wetland ecology, cytology, ecology, morphology, mycology, physiology and molecular biology, or systematics and evolution.

The department also participates in the inter-departmental majors in Ecology and Evolutionary Biology; Genetics; Molecular, Cellular, and Developmental Biology; Plant Physiology; Toxicology; and Water Resources. (See *Index*.)

Prospective graduate students need a sound background in the physical, biological, and mathematical sciences and English. The department requires submission of Graduate Record Examination aptitude test scores.

Courses open for nonmajor graduate credit: 303, 320, 321, 330, 401, 403I, 404, 406, 422I, 484, 484I.

Courses Primarily for Undergraduate Students

Bot 102. Biology of Plants. (2-4) Cr. 2. F.SS. 8 weeks. Function, structure, development, and evolution of plants. Primarily for students who do not have a professional interest in plant science. Materials fee.

Bot 202. Field Botany. (2-4) Cr. 2. F.SS. 8 weeks. Field and laboratory studies of plants in various local habitats. Includes trees, shrubs, flowering plants and other green plants, lichens and fungi. Not recommended for students with professional interest in plant science. Field trip fee.

Bot 301I. Iowa Natural History. (Same as Ia LL 301I.) See *Iowa Lakeside Laboratory*.

Bot 302I. Plant-animal Interactions. (Same as Ia LL 302I.) See *Iowa Lakeside Laboratory*.

Bot 303. Biological Evolution. (Same as Biol 303.) See *Biology*. Nonmajor graduate credit.

Bot 304. Plants and People. (3-0) Cr. 3. S. *Prereq:* *Credit or enrollment in Biol 201.* Wallace. Uses of plants and fungi by humans and the importance of plants in the past, present and future. Discussion of fruits, vegetables, grains, herbs, spices, beverages, oils, fibers, wood, medicines, and drugs, in the context of their agricultural, cultural, and economic roles in modern societies. Emphasis on origins and worldwide diversity of culturally important plants, their characteristics, and uses.

Bot 306. Plant Taxonomy. (2-4) Cr. 4. S. *Prereq:* *Biol 201.* Wendel. Principles of plant classification, survey of flowering plant families, identification and field study of local plants. Field trip fee.

Bot 312. Ecology. (Same as Biol 312.) See *Biology*.

Bot 312I. Ecology. (Same as la LL 312I.) See *Iowa Lakeside Laboratory*.

Bot 320. Plant Physiology. (3-0) Cr. 3. S. *Prereq:* *Biol 301 or Gen 320; Biol 302 or BBMB 301; Chem 231 or 332; Phys 106 or 111.* Spalding. Application of physical and biological principles to the understanding of plant processes involved in assimilation, metabolism, and regulation of growth and development. Nonmajor graduate credit.

Bot 321. Plant Physiology Laboratory. A: (0-3) Cr. 1. S. B: (0-6) Cr. 2. S. *Prereq:* *Biol 202L; credit or enrollment in 320.* Spalding. Laboratory to accompany 320. 321B will include independent group research projects. Nonmajor graduate credit.

Bot 330. Environmental Systems. (Same as Env S 330, EnSci 330.) (2-4) Cr. 4. F. *Prereq:* *Biol 202 or Micro 201, Chem 164 or 178, Math 165 or 181.* Crumpton. Dynamics of natural environmental systems. Systems approach to the analysis of material and energy flows, including physical and biological aspects of environmental systems and their functional connections. Laboratory emphasizes environmental modeling and simulation. Nonmajor graduate credit.

Bot 340. Biodiversity. (Same as Env S 340.) (4-0) Cr. 2. S. Second 8 weeks. *Prereq:* *One course in natural sciences or Environmental Studies.* Clark. Survey of the major groups of organisms and biological systems. Definition, measurement, and patterns of distribution of organisms. Sources of information about biodiversity. Not intended for major credit in the biological sciences.

Bot 356. Dendrology. (Same as For 356.) (2-6) Cr. 4. F. *Prereq:* *Biol 201.* Farrar. Taxonomy, morphology, and ecology of North American species of woody plants of importance in timber production and wildlife food and cover. Field trip fee.

Bot 364. Biology of Aquatic Plants and Algae. (2-2) Cr. 3. S. *Prereq:* *Biol 202 or Micro 201.* Introduction to algae and aquatic plants with emphasis on ecological relationships in lakes, rivers, and wetlands.

Bot 364I. Biology of Aquatic Plants. (Same as la LL 364I.) See *Iowa Lakeside Laboratory*.

Bot 367I. Plant Taxonomy. (Same as la LL 367I.) See *Iowa Lakeside Laboratory*.

Bot 399. Undergraduate Seminar. (1-0) Cr. 1 each time taken. S. *Prereq:* *Junior classification and 8 credits in botany.* Knaphus. Meetings of students and faculty to discuss topics of current interest in plant science. Opportunity to develop written and oral communication skills.

Bot 401. Environmental Analysis of Watersheds: Biogeochemistry Dynamics. (Same as EnSci 401, Geol 401.) (3-2) Cr. 4. S. *Prereq:* *EnSci 330.* Hoyle and Raich. Biological, chemical, and physical phenomena controlling material, energy, and elemental fluxes in the environment. Nonmajor graduate credit.

Bot 403I. Evolution. (Same as la LL 403I.) See *Iowa Lakeside Laboratory*. Nonmajor graduate credit.

Bot 404. Plant Anatomy. (2-3) Cr. 3. F. *Prereq:* *Biol 202L; 306 recommended.* Characteristics of cell and tissue types in vascular plants. Anatomy of developing and mature stems, roots, and leaves, including secondary (woody) growth. Introduction to the special anatomy of flowers and seeds. Nonmajor graduate credit.

Bot 406. Principles of Mycology. (Same as Micro 406.) (2-3) Cr. 3. F. *Prereq:* *10 credits in biological sciences.* Tiffany. Morphology, taxonomy and ecology of fungi; their relation to agriculture and industry. Nonmajor graduate credit.

Bot 422I. Prairie Ecology. (Same as la LL 422I.) See *Iowa Lakeside Laboratory*. Nonmajor graduate credit.

Bot 484. Plant Ecology. (3-0) Cr. 3. S. *Prereq:* *Biol 312.* Moloney. Principles of plant population, community, and ecosystem ecology. Nonmajor graduate credit.

Bot 484I. Plant Ecology. (Same as la LL 484I.) See *Iowa Lakeside Laboratory*. Nonmajor graduate credit.

Bot 487. Aquatic and Wetland Microbial Ecology. (Dual-listed with 587; same as EnSci 487, Micro 487.) (3-0) Cr. 3. S. *Prereq:* *6 credits in biology and 6 credits in chemistry.* Crumpton. Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in aquatic and wetland ecosystems. Emphasis on energy flow and nutrient dynamics. Nonmajor graduate credit.

Bot 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq:* *7 credits in botany, permission of instructor.* No more than 9 credits of 490 may be counted toward a degree in botany.

- A. Plant Physiology and Molecular Biology
- B. Morphology
- D. Mycology
- E. Systematics and Evolution
- F. Plant Ecology
- H. Honors
- I. Iowa Lakeside Laboratory (Same as la LL 490I) See *Iowa Lakeside Laboratory*.
- J. Cytology
- K. Aquatic and Wetland Ecology

Courses Primarily for Graduate Students, open to qualified undergraduate students

Bot 501I. Freshwater Algae. (Same as la LL 501I.) See *Iowa Lakeside Laboratory*.

Bot 505. Plant Diversity and Evolution. (2-6) Cr. 4. Alt. S., offered 2001. *Prereq:* *10 credits in biological sciences.* Farrar. Current concepts of plant phylogeny from the origin of land plants through the origin of angiosperms, with emphasis on morphology, reproduction and evolutionary trends in bryophytes, pteridophytes, and gymnosperms.

Bot 511. Plant Nutrition and Water Relations. (2-0) Cr. 2. S. *Prereq:* *320.* Mineral nutrition, ion and water relations, translocation in vascular plants, and physiological responses to abiotic stresses.

Bot 512. Plant Growth and Development. (Same as Gen 512, MCDB 512.) (2-0) Cr. 2. S. *Prereq:* *320 or a course in developmental biology; 545 or BBMB 404, 405 or Gen 520.* Wurtele and Becraft. Plant growth and development and its molecular genetic regulation. Hormone biosynthesis, metabolism, and action. Signal transduction in plants.

Bot 513. Plant Metabolism. (2-0) Cr. 2. F. *Prereq:* *320, Phys 111, Chem 331; one semester of biochemistry recommended.* Spalding. Photosynthesis, respiration, and other aspects of plant metabolism.

Bot 529. Plant Cell Biology. (Same as MCDB 529.) (2-0) Cr. 2. S. *Prereq:* *320, Biol 301, 302 or BBMB 405.* Rodermel. Organization, function, and development of plant cells and subcellular structures.

Bot 531I. Conservation Biology. (Same as la LL 531I.) See *Iowa Lakeside Laboratory*.

Bot 542. Introduction to Molecular Biology Techniques. (Same as Zool 542.) See *Zoology*.

Bot 545. Plant Molecular Biology. (Same as MCDB 545.) (3-0) Cr. 3. F. *Prereq:* *320, Biol 302.* Colbert. Organization and function of plant nuclear and organelle DNA; regulation of gene expression. Methods of generating novel genetic variation. Impact of plant biotechnology on agriculture.

Bot 552. Pteridology. (1-3) Cr. 2. Alt. SS., offered 2000. *Prereq:* *10 credits in biological sciences.* Farrar. Morphology, taxonomy, and ecology of the lower vascular plants, with emphasis on ferns. Field trip fee.

Bot 553. Sexual Reproduction in Flowering Plants. (2-0) Cr. 2. Alt. S., offered 2000. *Prereq:* *10 credits in biological sciences, including Bot 306.* Structural and functional aspects of stamen/pollen and ovule/embryo sac development; pollination, pollen tube growth and fertilization; embryo and endosperm development.

Bot 558. Paleobotany. (1-3) Cr. 2. Alt. S., offered 2000. *Prereq:* *10 credits in biological sciences.* Farrar. Introduction to morphology, identification, and phylogeny of fossil plants from Pre-Cambrian to present.

Bot 560I. Restoration Ecology. (Same as la LL 560I.) See *Iowa Lakeside Laboratory*.

Bot 564. Wetland Ecology. (3-0) Cr. 3. S. *Prereq:* *15 credits in biological sciences.* van der Valk. Ecology, classification, creation and restoration, and management of wetlands. Emphasis on North American temperate wetlands.

Bot 564I. Wetland Ecology. (Same as la LL 564I.) See *Iowa Lakeside Laboratory*.

Bot 570. Landscape Ecology. (Same as A Ecl 570.) (2-3) Cr. 3. Alt. F., offered 2000. *Prereq:* *Permission of instructor; Bot 588 or A Ecl 588; a course in calculus.* The study of ecological and evolutionary processes within a spatial context with emphasis on behavior, population and community dynamics. Field trip fee.

Bot 575. Field Mycology. (2-6) Cr. 4 each time taken. SS. *Prereq:* *5 credits in botany.* Tiffany. Collection and identification of fungi and relation of their occurrence to environmental factors. Field trips.

Bot 575I. Field Mycology. (Same as la LL 575I.) See *Iowa Lakeside Laboratory*.

Bot 580I. Ecology and Systematics of Diatoms. (Same as la LL 580I.) See *Iowa Lakeside Laboratory*.

Bot 582. Functional Ecology. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* *Biol 312.* Jurik. The nature of adaptations to physical and biotic environments. Biophysical, biomechanical, and physiological bases of the structure, form, growth, distribution, and abundance of organisms.

Bot 583. Techniques in Functional Ecology. (1-3) Cr. 2. Alt. S., offered 2001. *Prereq:* *Credit or enrollment in 582.* Jurik. Laboratory and field approaches to plant water relations, photosynthesis, energy balance, structure, and growth. Modern techniques of data acquisition and analysis. Field trip fee.

Bot 584. Ecosystem Ecology. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* *Combined 12 credits in biology and chemistry.* Survey of the structure and functioning of major terrestrial ecosystems. Nutrient cycles, energy flows, and biotic and abiotic controls over ecosystem structure and composition.

Bot 585. Community Ecology. (2-3) Cr. 3. Alt. F., offered 2000. *Prereq:* *484.* Factors controlling species diversity, species abundance, and the structure and function of communities in space and time. Weekend field trips to various vegetation types. Field trip fee.

Bot 587. Aquatic and Wetland Microbial Ecology. (Dual-listed with 487; same as Micro 587.) (3-0) Cr. 3. S. *Prereq:* *6 credits in biology and 6 credits in chemistry.* Crumpton. Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in aquatic and wetland ecosystems. Emphasis on energy flow and nutrient dynamics.

Bot 588. Population Ecology. (Same as A Ecl 588.) (2-2) Cr. 3. F. *Prereq:* *Biol 312, Stat 401, a course in calculus.* Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

Bot 590. Special Topics. Cr. 1 to 3 each time taken. *Prereq:* *10 credits in botany, permission of instructor.*

- A. Plant Physiology and Molecular Biology
- B. Morphology
- D. Mycology
- E. Systematics and Evolution
- F. Plant Ecology
- I. Iowa Lakeside Laboratory (Same as la LL 590I.) See *Iowa Lakeside Laboratory*.

J. Cytology
K. Aquatic and Wetland Ecology

Bot 595. Agrostology. (2-3) Cr. 3. Alt. F., offered 2000. *Prereq:* 306. Clark. Structure, identification, classification, phylogeny, and economic aspects of grasses and related families.

Bot 596. Advanced Plant Systematics. (2-6) Cr. 4. Alt. F., offered 2001. *Prereq:* *Permission of instructor.* Clark, Wallace, Wendel. Principles of plant classification and phylogenetic theory; processes of plant speciation; sources and interpretation of systematic data; examination of research methods and their applications; plant nomenclature.

Bot 599. Creative Component. Cr. arr. Research toward nonthesis master's degree.

Courses for Graduate Students

Bot 612. Seminar in Plant Development. (Same as Gen 612.) Cr. 1 each time taken. S. *Prereq:* *Bot/Gen 512 (can be taken concurrently).* Becraft, Wurtele. In-depth discussion and critique of journal articles on current topics of interest to participants.

Bot 641. General Mycology. (Same as Micro 641.) (2-6) Cr. 4. F. *Prereq:* *PI P 407.* Tiffany. First semester of a full-year course. Taxonomy, morphology, ecology, and phylogeny of slime molds and fungi (oomycetes, chytridiomycetes, zygomycetes, ascomycetes, basidiomycetes, and fungi imperfecti). Materials fee.

Bot 642. General Mycology. (Same as Micro 642.) (2-6) Cr. 4. S. *Prereq:* 641. Tiffany. Continuation of 641. Taxonomy, morphology, ecology, and phylogeny of slime molds and fungi (oomycetes, chytridiomycetes, zygomycetes, ascomycetes, basidiomycetes, and fungi imperfecti). Materials fee.

Bot 679. Light Microscopy. (Same as Micro 679.) (2-9) Cr. 5. Every fourth semester beginning Fall 1999. *Prereq:* *Permission of instructor.* Horner. Current theories encompassing light optics and their applications for specimen preservation, paraffin and resin sectioning, general staining, histochemistry, cytophotometry, immunocytochemistry, autoradiography, image digitization, processing and presentation, and photomacro- and photomicrography. Materials fee. Limit of 10 students.

Bot 680. Scanning Electron Microscopy. (Same as Micro 680.) (2-9) Cr. 5. Every fourth semester beginning Fall 2000. *Prereq:* *Permission of instructor.* Horner. Current theories encompassing scanning electron optics and their applications for high and low vacuum microscopy, specimen chemical and cryopreservation methods, x-ray microanalysis, backscattered and topographic imaging, image digitization, processing and presentation, and photomicrography. Materials fee. Limit of 10 students.

Bot 681. Transmission Electron Microscopy. (Same as Micro 681.) (2-9) Cr. 5. Every fourth semester beginning Spring 2000. *Prereq:* *Bot 679 and permission of instructor.* Horner. Current theories encompassing electron optics and their applications for chemical and physical specimen preservation, ultramicrotomy, general staining and cytochemistry, immunocytochemistry, autoradiography, negative staining and shadowing, x-ray microanalysis, image digitization, processing and presentation, and photomicrography. Materials fee. Limit of 10 students.

Bot 696. Seminar in Plant Physiology and Molecular Biology. (Same as Agron 696, BBMB 696, For 696, Gen 696, Hort 696, MCDB 696, P Phy 696.) Cr. 1 each time taken. F.S. Presentations and discussions of recent literature and problems under investigation.

Bot 698. Seminar. Cr. 1 each time taken. Meetings of botany faculty and students to discuss recent literature and problems under investigation.

- A. Vascular Plants
- B. Non-vascular Plants
- C. Systematics and Evolution
- D. For all faculty and students in botany
- E. Molecular, Cellular, and Developmental Biology (Same as MCDB 698.) See *Molecular, Cellular, and Developmental Biology.*
- F. Ecology
- G. Aquatic and Wetland Ecology

- Bot 699. Research.** Cr. var.
 - A. Plant Physiology and Molecular Biology
 - B. Morphology
 - D. Mycology
 - E. Systematics and Evolution
 - F. Plant Ecology
 - I. Iowa Lakeside Laboratory (Same as Ia LL 699I.) See *Iowa Lakeside Laboratory.*
 - J. Cytology
 - K. Aquatic and Wetland Ecology

Courses Offered at the Gulf Coast Research Laboratory (GCRL), Ocean Springs, Mississippi

The Gulf Coast Research Laboratory is affiliated with the University of Southern Mississippi. Iowa State students may register for the following University of Southern Mississippi/GCRL courses and transfer them to their ISU degree programs. Written permission of the ISU coordinator for the GCRL, 201 Bessey, is required for this arrangement. Inquire at 201 Bessey for further information.

MAR 420. Marine Phycology. Cr. 2. SS. *Prereq:* 10 credits in biology, including botany. A survey, based upon local examples, of the principal groups of marine algae, treating structure, reproduction, distribution, identification, and ecology.

MAR 420L. Marine Phycology Lab. Cr. 2. SS. Lab to accompany 420.

MAR 421. Coastal Vegetation. Cr. 2. SS. *Prereq:* 10 credits in biology including botany. A study of general and specific aspects of coastal vegetation with emphasis on local examples.

MAR 421L. Coastal Vegetation Lab. Cr. 1. SS. Lab to accompany 421.

MAR 422. Salt Marsh Plant Ecology. Cr. 2. SS. The botanical aspects of local marshes; includes plant identification, composition, and structure.

MAR 422L. Salt Marsh Plant Ecology Lab. Cr. 2. SS. Lab to accompany 422.

MAR 490. Independent Study.

MAR 491. Special Topics.

Business Administration

Benjamin J. Allen, Dean

Labh S. Hira, Associate Dean

Undergraduate Study

Labh S. Hira, Professor in charge, Undergraduate Programs in Business.

For undergraduate curriculum leading to the degree bachelor of science, majors in accounting, finance, management, management information systems, marketing, production/operations management, transportation and logistics and a secondary major in international business, see *College of Business, Curricula.*

The department of Business Administration supports the undergraduate programs in the departments of Accounting, Finance, Logistics, Operations, and Management Information Systems, Management, and Marketing by providing specialized coursework in orientation to business, an introduction to careers in business, and cooperative education opportunities.

Graduate Study

Labh S. Hira, Professor in Charge, Graduate Programs in Business

Two programs are offered at the graduate level: a master of business administration (M.B.A.) program and a master of science (M.S.) in business administrative sciences program.

Master of Business Administration (M.B.A.)

The College of Business offers a 48 credit program leading to a nonthesis master of business administration degree with a specialization in accounting, agribusiness, finance, manufacturing and quality information systems, or marketing or an emphasis in one of the functional areas of business. This program prepares students for careers in business. The coursework is designed to provide the knowledge, skills, and abilities for managerial success and leadership in organizations. The M.B.A. is the professional management education program for those pursuing careers in business or industry.

Students working toward the master of business administration are required to complete a series of core courses in the basic disciplinary and functional areas of business (accounting, economics, statistics, finance, marketing, operations management, organizational behavior, management information systems, international business, ethics and social responsibility, strategic management and business policy), and advanced elective coursework.

Courses for the M.B.A. are provided by the departments of Accounting, Economics, Finance, Logistics, Operations and Management Information Systems, Management, Marketing, and Statistics. Courses from other departments may also be chosen to meet specific student interests. Students interested in the agribusiness specialization may need to fulfill production agriculture requirements by taking courses in the College of Agriculture. Double degree programs are offered with architecture (M.Arch./M.B.A.), community and regional planning (M.B.A./M.C.R.P.), and statistics (M.B.A./M.S.-Statistics).

Students may enroll in either the full-time program or the part-time Saturday program. The latter is intended for those individuals who desire an M.B.A. without interrupting their employment.

The M.B.A. program is open to all individuals with a baccalaureate degree. It is not essential that applicants have previous business-related education. Undergraduates from liberal arts, science, and technical programs are especially encouraged to apply. However, some accounting, economics, and statistics knowledge and computer skills would be beneficial. Academic potential and promise for a productive career in business and for managerial success and leadership in organizations are important criteria for admission. Applicants must submit Graduate Management Admission Test (GMAT) scores, official transcripts of previous academic work, personal essays, resume, and three letters of reference. International students whose native language is not English

and who did not graduate from a U.S. college or university are required to submit the Test of English as a Foreign Language (TOEFL) scores.

Fully-admitted M.B.A. degree candidates with previous business study as an undergraduate may qualify for advanced entry into the M.B.A. program. Advanced entry is designed to serve those students with a bachelor's degree in business as they may complete the M.B.A. degree program requirements in as few as 30 semester credit hours. Information about the advanced M.B.A. entry application process can be obtained in the College of Business Graduate Programs Office, 218 Carver Hall.

Admissions offers to the MBA program are generally made only for fall semester entry. Applicants are encouraged to submit their application materials by May 1 (March 1 for international students).

Master of Science (M.S.) in Business Administrative Sciences

The College of Business offers graduate work leading to the master of science degree with a major in business administrative sciences. All the departments in the college, (Accounting, Finance, Logistics, Operations and Management Information Systems, Management, and Marketing), and the departments of Economics and Statistics cooperate in providing coursework toward this degree. The program is designed to serve those students who desire specialized study of an area within business at the master's level. It also serves to develop their research capabilities.

The M.S. degree is better suited for students with degrees or backgrounds in business as they may complete the program within the 30 credit minimum. Students without business backgrounds are required to fulfill pre-requisites and common body of knowledge coursework in accounting, finance, management information systems, marketing, organizational behavior, operations management, global business, and business ethics. The program is composed of 6 credits of required courses in economics and statistics plus 3 to 6 credits of thesis and 18 to 21 credits of coursework in an area of emphasis. The student, with the help of a program of study committee, designs an educational program in specialized functional or industry areas within business.

Application deadline for the M.S. program is May 1 for fall admission and October 1 for spring admission. Applicants must submit official transcripts of previous educational coursework and degrees, the Graduate Management Admission Test (GMAT) scores, personal essays, resume, and three letters of reference. International students whose native language is not English and who did not graduate from a U.S. college or university are required to submit the Test of English as a Foreign Language (TOEFL) scores.

Courses Primarily for Undergraduate Students

BusAd 100. Orientation. (1-0) Cr. R. F.S.S.S. First 8 weeks. Group advising for pre-business and business majors. Review of college and university requirements, transfer credits, academic planning, university policies and deadlines, and registration procedure.

Offered on a satisfactory-fail grading basis only.

BusAd 100H. Orientation. (1-0) Cr. R. F. 8 weeks. *Prereq: Membership in the Freshman Honors Program.* Designed to supplement the Freshman Honors orientation (Hon 121) with college specific information, to facilitate the development of Honors programs of study in business, and to acquaint students with university policies and procedures. Offered on a satisfactory-fail grading basis only.

BusAd 200. Introduction to Careers in Business. (1-0) Cr. 0.5 F.S. 8 weeks. *Prereq: Sophomore classification.* Introduction to career fields open to business majors. Presentations by business professionals in various areas of business. Offered on a satisfactory-fail grading basis only.

BusAd 291. Experiential Learning. Cr. 1 to 3 each time taken. *Prereq: Written approval of supervising instructor and department chair on required form prior to the learning experience.* Supervised travel and/or work experience in a business related discipline. Offered on a satisfactory-fail basis only.

- A. Domestic Internship.
- B. International Internship.
- C. Domestic Travel and Study.
- D. International Travel and Study.

BusAd 300. Cooperative Education. Cr. R. *Prereq: Permission of department.* Required of all cooperative students. Students must register for this course prior to commencing each work period. Not available to full-time students.

BusAd 301. Professional Employment Preparation. (1-0) Cr. 1. Develop and enhance skills needed for permanent professional or internship/co-op job search. Uses readings, lectures, discussion groups, media resources and an employer panel. Offered on a satisfactory-fail basis only.

BusAd 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq: 490A: Mgmt 414, Mkt 448, Trilog 466 or Fin 452: senior classification, permission of instructor; for 490H: Admission to the Business Honors Program.*

- A. International Business
- H. Honors

BusAd 491. Professional Experiential Learning. Cr. 1 to 3 each time taken. *Prereq: Professional program, 12 credits from College of Business; written approval of supervising instructor and department chair on required form prior to the learning experience.* Supervised travel and/or work experiences in a business related discipline. Offered on a satisfactory-fail basis only.

- A. Domestic Internship.
- B. International Internship.
- C. Domestic Travel and Study.
- D. International Travel and Study.
- E. Other Experiential Learning Experience.

Courses Primarily for Graduate Students, open to qualified undergraduate students

BusAd 576. Contemporary Topics in Agribusiness Management I. (Same as Mgmt 576.) See *Management.*

BusAd 577. Contemporary Topics in Agribusiness Management II. (Same as Mgmt 577.) See *Management.*

BusAd 591. Professional Experiential Learning. Cr. 1 to 3 each time taken. *Prereq: Graduate standing; written approval of supervising instructor and department chair on required form prior to the learning experience.* Academically supervised travel and/or work experiences in a business related discipline. Offered on a satisfactory-fail basis only.

BusAd 599. Creative Component. Cr. 3. *Prereq: Graduate classification, permission of supervisory committee chair.* Preparation and writing of creative component.

- A. Accounting
- C. Finance
- E. Management
- F. Marketing
- H. Transportation and Logistics
- I. Agribusiness

- J. General Business
- K. Management Information Systems
- L. Production/Operations Management

BusAd 699. Research. Cr. 3 to 6, arranged. F.S.S.S. *Prereq: Graduate classification, permission of major professor.* Research.

Chemical Engineering

Charles E. Glatz, Chair of Department

Distinguished Professors: Doraiswamy, Reilly, Seagrave

University Professors: Wheelock

Professors: Brown, Glatz, Hill, Jolls, Nikolov, Schrader, Ulrichson, Youngquist

Distinguished Professors (Emeritus): Burnet, Larson

Professors (Emeritus): Abraham, Boylan

Associate Professors: Fox, Heath, Hebert, Rollins

Associate Professors (Adjunct): Hanneman

Associate Professors (Emeritus): Collins

Assistant Professors: Baldwin, Mallapragada, Otaigbe, Vigil

Undergraduate Study

For undergraduate curriculum in chemical engineering leading to the degree bachelor of science, see *College of Engineering, Curricula.* This curriculum is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

Chemical engineering is a profession which provides a link between scientific knowledge and manufactured products. The chemical engineer relies on science, experience, creativity, and ingenuity to produce these materials economically. Almost everything of a material nature used by society today has at some point felt the influence of the chemical engineer. From raw materials such as minerals, coal, petroleum, and agricultural products, chemical engineers create versatile intermediate and commodity chemicals, high performance fuels, new materials for construction, pharmaceuticals, high performance foodstuffs, synthetic textiles, plastics, solid state electronic components, and dozens of other engineered materials. The chemical engineer's influence has been important in the development of catalysts, fuel cells, automatic controls, biochemical processes, artificial kidneys, tissue engineering, nuclear energy, medical instruments and devices, as well as in the development of air and water pollution control systems. Many new and equally exciting challenges await the practicing chemical engineer of the future.

The profession of chemical engineering embraces a wide variety of activities including research, process development, product development, design, manufacturing supervision, technical sales, consulting, and teaching. The engineer can be behind a desk, in a labo-

ratory, in a manufacturing plant, or engaged in nationwide and worldwide travel.

Successful chemical engineers find chemistry, mathematics, and physics to be interesting and exciting. Many chemical engineers also have interest in the biological sciences. The curriculum in chemical engineering includes continued study of chemistry, mathematics, and physics as well as intensive study in the engineering sciences such as chemical reaction engineering, thermodynamics, mass transfer, fluid mechanics, heat transfer, system analysis and process synthesis, and design.

The curriculum in chemical engineering is designed to produce graduates that have the ability to apply knowledge of mathematics, science, and engineering; the ability to design, conduct and interpret experiments, and the ability to design a chemical engineering system, component, or process. Graduates should also have the ability to function on multi-disciplinary teams; the ability to identify, formulate, and solve chemical engineering problems; and the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The curriculum should also assure that graduates have the ability to communicate effectively, the broad education necessary to understand the impact of chemical engineering solutions in a global and societal context, and recognition of the need for, and an ability to engage in life-long learning, as well as a knowledge of contemporary issues and an understanding of professional and ethical responsibility.

The curriculum assures that graduates have a thorough grounding in chemistry, along with a working knowledge of advanced chemistry such as organic, inorganic, physical, analytical, materials chemistry, or biochemistry. In addition, a working knowledge, including safety and environmental aspects, of material and energy balances applied to chemical processes; thermodynamics of physical and chemical equilibria; heat, mass, and momentum transfer; chemical reaction engineering; continuous and stage-wise separation operations; process dynamics and control; process design; and appropriate modern experimental and computing techniques is assured.

A significant number of chemical engineering graduates should have an ability to function as engineers in an international setting, and an ability to pursue research and advanced studies in chemical engineering, or in related fields such as medicine, law, and business.

A cooperative education program is available to students in chemical engineering. See *Cooperative Programs, College of Engineering*.

Graduate Study

The department offers work for the degrees master of science, master of engineering, and doctor of philosophy with major in chemical engineering, and minor work to students taking major work in other departments.

Prerequisite to major graduate work is a bachelor's degree in chemical engineering, 1999-2001

or's degree in chemical engineering, chemistry, or other related field. Students with undergraduate background other than chemical engineering should contact the department for further details.

The master of engineering degree requires a creative component. A thesis is required for the master of science degree.

Courses open for nonmajor graduate credit: All 300 and 400 level courses except 302, 391, 392, 396, 397, 398, 401, 490, 492, 493, and 498.

Courses Primarily for Undergraduate Students

Ch E 210. Material and Energy Balances. (3-0) Cr. 3. F.S. *Prereq: Chem 178, Math 166.* Introduction to chemical processes. Physical behavior of gases, liquids, and solids. Application of material and energy balances to chemical engineering equipment and processes.

Ch E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; Sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Ch E 302. Seminar. (1-0) Cr. R. S. *Prereq: Sophomore classification in chemical engineering.* Offered on a satisfactory-fail grading basis only.

Ch E 325. Chemical Engineering Laboratory I. (0-4) Cr. 2. F.S. *Prereq: 357, credit or enrollment in 381.* Experiments covering fundamental material and energy balances, momentum and energy transport operations, thermodynamics. Computer applications. Nonmajor graduate credit.

Ch E 356. Transport Phenomena I. (3-0) Cr. 3. F.S. *Prereq: 210, Phys 221, credit or enrollment in Math 267.* Momentum and mechanical energy balances. Incompressible and compressible fluid flow. Applications to fluid drag, piping system design, filtration, packed beds and settling. Introduction to conductive and convective heat transfer. Nonmajor graduate credit.

Ch E 357. Transport Phenomena II. (3-0) Cr. 3. F.S. *Prereq: 356.* Conduction and diffusion, convective heat and mass transfer, boiling and condensation, radiation, design of heat exchange equipment. Diffusion and mass transfer. Design of mass transfer equipment. Nonmajor graduate credit.

Ch E 358. Separations. (3-0) Cr. 3. F.S. *Prereq: 357.* Diffusion and mass transfer in fluids. Analysis and design of continuous contacting and multistage separation processes. Binary and multicomponent distillation, absorption, extraction, evaporation, simultaneous heat and mass transfer. Nonmajor graduate credit.

Ch E 381. Chemical Engineering Thermodynamics. (3-0) Cr. 3. F.S. *Prereq: Math 267, Phys 222, Chem 321.* Application of thermodynamic principles to chemical engineering problems. Thermodynamic properties of fluids, phase equilibria, chemical reaction equilibria. Nonmajor graduate credit.

Ch E 382. Chemical Reaction Engineering. (3-0) Cr. 3. F.S. *Prereq: 381, credit or enrollment in 357.* Kinetics of chemical reactions; design of homogeneous and heterogeneous chemical reactors. Nonmajor graduate credit.

Ch E 391. Foreign Study. (1-0) Cr. 1. S. *Prereq: 356, permission of instructor.* Preparation for foreign study program. Offered on a satisfactory-fail basis only. Credit for graduation allowable only upon completion of 392.

Ch E 392. Foreign Study Program. Cr. 2-6. SS. *Prereq: 391.* Study of chemical engineering including laboratories and lectures at University College London or other collaborating international universities. Comparative study of U.S. and international manufacturing facilities. Expenses required. Offered on a satisfactory-fail grading basis only. Field trip fee.

Ch E 396. Summer Internship for International Students. Cr. R. SS. *Prereq: Permission of department.* Summer professional work period for international students.

Ch E 397. Engineering Internship. Cr. R. F.S. *Prereq: Permission of department.* One semester maximum per academic year professional work period.

Ch E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; Junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Ch E 401. Seminar. (1-0) Cr. R. F. *Prereq: Senior classification in chemical engineering.* Offered on a satisfactory-fail grading basis only.

Ch E 405. Chemical Process Safety, Health and Environment. (2-0) Cr. 2. S. *Prereq: Credit or enrollment in 358, 381.* Study of the regulations governing process safety and health and the responsibility of engineers in process design and maintenance. Topics include toxicology, industrial hygiene, toxic source and dispersion models, hazards identification and control, and risk assessment. Nonmajor graduate credit.

Ch E 406. Environmental Processing Operations. (3-0) Cr. 3. F. *Prereq: 358, 382.* Study of the opportunities, responsibilities, and history of chemical engineers in preservation of the environment. Analysis and design of equipment to recover, recycle, or destroy contaminants in gas, solid, or liquid substrates. Mechanical, chemical, thermal, and biochemical processing. Nonmajor graduate credit.

Ch E 410. Industrial and Engineering Chemistry. (2-3) Cr. 3. F. *Prereq: 382 and Chem 331 or graduate classification in chemistry or material science and engineering.* Integration and synthesis of chemical engineering and chemistry as practiced in modern industry. Engineering of chemical reactions and processes. Processing routes and product engineering for commodity chemicals, petroleum-based fuels, petrochemicals, intermediates, specialty chemicals, pharmaceuticals, and engineered materials. Environmental strategies for waste/by-product minimization and pollution prevention. Nonmajor graduate credit.

Ch E 415. Biochemical Engineering. (3-0) Cr. 3. S. *Prereq: 357, 382 recommended, Chem 331.* Application of basic chemical engineering principles in biochemical and biological process industries such as enzyme technology and fermentation. Nonmajor graduate credit.

Ch E 421. Process Control. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in 358, Math 267.* Control of industrial chemical processes. Device applications and limitations. Dynamics of chemical process components and process control systems. Nonmajor graduate credit.

Ch E 426. Chemical Engineering Laboratory II. (0-4) Cr. 2. F.S. *Prereq: 325, 358, 382.* Experiments in heat and mass transfer, staged operations, chemical reactor performance, unit processes. Computer applications. Nonmajor graduate credit.

Ch E 430. Process and Plant Design. (2-6) Cr. 4. F.S. *Prereq: 358, 382.* Synthesis of chemical engineering processes, equipment and plants. Cost estimation and feasibility analysis. Nonmajor graduate credit.

Ch E 441. Modeling and Simulation for Chemical Processes. (3-0) Cr. 3. S. *Prereq: 358, 382.* Simulation of behavior of chemical processes, trial and error calculations, numerical integration and other numerical methods. Problems involving fluid flow, distillation, heat transfer, process control, and reactor design. Nonmajor graduate credit.

Ch E 443. Polymers and Polymer Engineering. (3-0) Cr. 3. F. *Prereq: 357, Chem 331.* Chemistry of polymers, addition and condensation polymerization. Physical and mechanical properties, polymer rheology, production methods. Applications of polymers in the chemical industry. Nonmajor graduate credit.

Ch E 470. Petroleum Production and Refining. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: Chem 178.*

Introduction to production and refining of petroleum and natural gas: origins and characterization; methods of exploration, production, transportation, and refining. Suitable for most advanced undergraduates and graduate students in the physical sciences and engineering. Nonmajor graduate credit.

Ch E 490. Independent Study. (0-3 to 0-18) Cr. 1 to 6. Introduction to research methods; investigation of an approved topic.
H. Honors

Ch E 492. International Technology and Globalization. (0-3 to 6-18) F.S.SS. Cr. 2-12. Technology and applied science within an international perspective. Investigation of global-oriented companies, research organizations, and international university environments. Independent study in preparation for or during internship program. Taken with attendance at cooperating international university.

Ch E 493. International Internship. Cr. R. F.S.SS. International professional work experience related to global strategic technology. Case studies and technical assessment of projects.

Ch E 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; Senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, open to qualified undergraduate students

Ch E 539. Fluidized Bed Processes. (Same as M E 539.) See *Mechanical Engineering*.

Ch E 540. Biomedical Applications of Chemical Engineering. (Same as B M E 540.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: 210, Math 266, Phys 222.* Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomedical and biochemical engineering, applied physiology, and environmental studies.

Ch E 545. Analytical and Numerical Methods. (3-0) Cr. 3. F. *Prereq: 358, Math 267.* Analysis of equipment and processes by analytic and/or numerical solution of descriptive differential equations. Operational and series techniques, boundary value problems, numerical interpolation and approximation, integration techniques.

Ch E 552. Transport Phenomena I. (3-0) Cr. 3. F. *Prereq: 357, 381, Math 267, credit or enrollment in 545.* Equations of change for mass, energy, and momentum. Introduction to transport in multicomponent systems. Exact and approximate solutions to the equations of motion.

Ch E 553. Transport Phenomena II. (3-0) Cr. 3. S. *Prereq: 552.* Convective and radiative heat transfer, boiling, condensation, multicomponent diffusion, mass transfer models. High transfer rate effects. Simultaneous heat, mass, and momentum transfer.

Ch E 558. Advanced Mass Transfer Operations. (3-0) Cr. 3. F. *Prereq: 358.* Analysis of chemical processes based on unit operations. Focus on mass transfer process interaction with momentum and heat transfer.

Ch E 562. Bioprocesses. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: 357 or advanced standing in a science major.* Principles and techniques for separation and recovery of biologically-produced molecules, especially proteins. Relationship between the chemistry of biological molecules and efficient separation and preservation of biological activity. Includes centrifugation and filtration, membrane processing, extraction, precipitation and crystallization, chromatography, and electrophoresis.

Ch E 565. Processing of Solid State Materials. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: 382.* Application of chemical engineering principles in the semiconductor and related industries. Analysis of chemical and physical processes in materials fabrication.

Ch E 572. Turbulence. (Same as Aer E 572.) See *Aerospace Engineering*.

Ch E 583. Advanced Thermodynamics. (3-0) Cr. 3. S. *Prereq: 381.* Application of thermodynamic principles to chemical engineering problems. Thermodynamic properties of non-ideal fluids and solutions; phase and chemical-reaction equilibria/stability.

Ch E 587. Advanced Chemical Reactor Design. (3-0) Cr. 3. F. *Prereq: 382.* Analysis of complex reactions and kinetics. Fixed bed, fluidized bed, and other industrial reactors. Analysis and design of non-ideal flow mixing, and residence times. Heterogeneous reactors.

Ch E 590. Special Topics. Cr. 2 to 6 each time taken. Investigation of an approved topic on an individual basis.

Ch E 595. Special Topics. Cr. 2 or 3 each time taken. *Prereq: Permission of instructor.*

- A. Separations
- B. Advanced Control Theory
- C. Crystallization
- D. Thermodynamics
- E. Kinetics and Catalysis
- F. Transport Operations
- G. Bioengineering
- H. Chemical Engineering Instrumentation
- I. Materials

Ch E 599. Creative Component. Cr. var.

Courses for Graduate Students

Ch E 601. Seminar. (1-0) Cr. R. F.S. Offered on a satisfactory-fail grading basis only.

Ch E 645. Advanced Calculation Methods for Chemical Engineers. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 545.* Advanced analysis and design of equipment and processes requiring specialized mathematical techniques.

Ch E 652. Advanced Momentum Transport. (2-0) Cr. 2. Alt. S., offered 2000. *Prereq: 552.* Advanced topics in momentum transport and fluid mechanics including study of recent literature.

Ch E 653. Advanced Mass Transport. (2-0) Cr. 2. Alt. F., offered 2000. *Prereq: 553.* Advanced topics in mass transport including study of recent literature.

Ch E 683. Non-Equilibrium Thermodynamics. (3-0) Cr. 3. Alt. SS., offered 2001 *Prereq: 552, 583.* Thermodynamics of irreversible processes including diffusion and sedimentation, electrochemical processes, muscle contraction, thermal diffusion, and membrane transport.

Ch E 688. Catalysis and Catalytic Processes. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 382.* Principles and applications of heterogeneous and homogeneous catalysis. Adsorption. Reaction kinetics and mass transfer effects. Catalyst characterization. Industrial catalytic processes.

Ch E 690. Advanced Topics. Cr. var.

Ch E 699. Research.

Associate Professors: Jenks, Miller, Petrich, Woo

Associate Professors (Adjunct): Russell, Trahanovsky

Assistant Professors: Sheares, Song

Undergraduate Study

For undergraduate curricula in liberal arts and sciences leading to the degrees bachelor of science and bachelor of arts, see *Liberal Arts and Sciences, Curriculum*.

Graduates holding the B.S. degree in chemistry qualify in many fields: as teachers of chemistry, as supervisors in industry, as technical sales personnel, and as research chemists in federal, state, municipal, academic, or industrial laboratories. Students with high scholastic standing often continue with graduate work, where they can explore more thoroughly the specialized areas of chemistry in which they are interested.

The B.A. degree is useful for students who intend to pursue studies in parallel areas, such as secondary school teaching, or to obtain joint majors or strong minors. The B.A. degree does not prepare students as well for graduate study or professional employment in chemistry.

Graduates have firm foundations in the fundamentals and application of current chemical theories. They are able to design, carry-out, record, and analyze the results of a chemical experiment. They are able to use modern instrumentation and classical techniques to identify and solve chemical problems as well as explore new areas of research. Graduates are able to communicate the results of their work to chemists, as well as non-chemists. They understand the ethical and environmental dimensions of problems and issues facing chemists. They follow the proper procedures and regulations for safe storage, labeling, use of chemicals, and disposal of chemicals. Graduates are skilled in problem solving, critical thinking, and analytical reasoning. These skills can be applied to careers in education and industry or professions such as law and medicine. The curricula in chemistry are approved by the American Chemical Society. Students who complete the program obtain an ACS certified baccalaureate degree.

Liberal arts majors who wish to transfer into chemistry at the end of their second year may still complete all degree requirements and graduate within five years.

Undergraduate students seeking the B.S. degree in chemistry usually take courses essential to the degree program according to the following schedule:

First year: Chem 177M, 177N, 178M, 210, 211L; Math 165, 166; Engl 104, 105; Lib 160.

Second year: Chem 331, 332, 333L, 334L; Math 265; Phys 221, 222.

Third year: Chem 321, 322, 322L, 316, 316L, 301; Engl 314; Foreign language requirement.

Fourth year: Chem 402, 401L, 2 advanced chemistry courses (minimum 4 credits). Chem 399 or 499 is strongly recommended, howev-

Chemistry

George A. Kraus, Chair of Department

Distinguished Professors: Angelici, Barton, Corbett, Espenson, Fritz, Gordon, Ng, Small, Yeung

Distinguished Professor (Emeritus): Russell
University Professors: Verkade

Professors: Franzen, Greenbowe, Hoffman, Houk, Jacobson, Johnson, Kostic, Kozak, Kraus, Larock, Porter, Rabideau, Struve, Thiel, Trahanovsky

Distinguished Professors (Emeritus): Ruedenberg, Svec

Professors (Emeritus): Gerstein, Hutton, Martin, McCarley, Powell, Voigt

er, credits earned in 399/499 can only be used to meet one of the advanced course requirements.

Chemistry majors seeking certification to teach chemistry in secondary schools must meet requirements of the College of Education as well as those of the chemistry program. In addition, they must apply formally for admission to the teacher education program.

Undergraduate students seeking the B.A. degree in chemistry have the following courses in their degree programs as minimum requirements: 177 (or 167), 177L (or 167L), 178, 211, 211L, 301, 316, 316L, 321, 321L or 322L, 322, 331, 331L, 332, 332L. Math 165, 166 and Phys 221, 222 are required as supporting work.

The department offers a minor in chemistry which may be earned by credit in Chem 177, 177L (or 167 and 167L), 178, 211, 211L, 321, 331, 331L and one of the following: Chem 301; 316, 316L or 322 and 321L, or 332 and 332L. The total minimum credits in chemistry thus will be 20 to 23 depending on which advanced courses are selected.

English proficiency requirement: The department requires a grade of C- or better in each of English 104, 105, and 314.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in analytical, inorganic, organic, and physical chemistry, as well as the degrees master of science and doctor of philosophy in chemistry. Co-majors may be taken between areas within chemistry or between one of the areas in chemistry and another department. Courses in other areas of chemistry as well as courses in other departments may be used to satisfy the requirement for coursework outside the major field. A Ph.D. student in chemistry may choose an additional speciality in one of the four areas: Materials Chemistry, Industrial Chemistry, Biomolecular Sciences, and Chemical Instrumentation. A minimum of ten credits is required for each additional speciality. A course which counts towards an additional speciality may also count toward the outside course requirement. A minor in chemistry is available to students in other departments. The department participates in the interdepartmental major in toxicology.

The Department of Chemistry requires all graduate students majoring in chemistry to teach as part of their training for an advanced degree.

Prerequisite to major graduate work is the completion of undergraduate work in chemistry, mathematics, and physics, substantially equivalent to that required of undergraduate students at this institution.

Courses open for nonmajor graduate credit: 301, 316, 316L, 321, 321L, 322, 331, 332, 401L, 402.

The course numbers for general chemistry courses include 50 and 160-178.

Index to field of work is given by the second and third digits of course numbers:

- Inorganic Chemistry 00-09
- Analytical Chemistry 10-19
- Physical Chemistry 20-29 and 60-69
- Organic Chemistry 30-40
- Interdisciplinary Chemistry 70-89
- Research 99

Courses Primarily for Undergraduate Students

Chem 50. Preparation for General Chemistry. (2-0) Cr. 0. F.S. *Prereq:* 1 year high school algebra. Basic methods and concepts of chemistry students must master before they are ready for college chemistry. For students intending to enroll in general chemistry and who have not taken high school chemistry or have otherwise deficient backgrounds.

Chem 155. Foundations of Chemistry for Engineers. (3-0) Cr. 3. F. *Prereq:* Math 140 or the high school equivalent. The first semester of a two semester sequence covering principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. Chem 155 may not be counted for credit toward graduation in any engineering curriculum. Credit may not be applied toward graduation for both 160 and another chemistry course. Only one of 163, 165, 167, and 177 may be counted toward graduation. Only one of 155, 163, 167, and 177 may be counted toward graduation.

Chem 160. Chemistry in Modern Society. (3-0) Cr. 3. S. Aspects of chemistry visible to a nonscientist in our society. A survey of selected areas of chemistry with emphasis on the interface between chemistry and other fields of human activity. Credit may not be applied toward graduation for both 160 and another chemistry course.

Chem 163. General Chemistry. (4-0) Cr. 4. F.S.SS. *Prereq:* 1 year of high school algebra and geometry and either Chem 50 or 155 or 1 year of high school chemistry; and credit or enrollment in 163L. The first semester of a two semester sequence. A general survey of chemistry and properties with an emphasis on conceptual problems. Stoichiometry, atomic structure, chemical bonding, states of matter, energy relations, acid-base theory and oxidation-reduction reactions, nuclear chemistry. The 163, 164 sequence does not meet the prerequisite for 331. Credit for examination (test-out exams) for 163, 164, 167, 177, and 178 is available only to students who are not currently enrolled in the course. Credit may not be applied toward graduation for both Chem 160 and another chemistry course. Only one of 163, 165, 167 and 177 may be counted toward graduation. Only one of 155, 163, 167, and 177 may be counted toward graduation.

Chem 163L. Laboratory in General Chemistry. (0-3) Cr. 1. F.S.SS. *Prereq:* Previous credit or enrollment for credit in 163. Laboratory to accompany 163. Must be taken with 163. Materials fee. Only one of 163L, 167L, and 177L may be counted toward graduation.

Chem 164. General Chemistry. (3-0) Cr. 3. F.S. *Prereq:* 163 and 163L. Continuation of 163. A general survey of chemistry and properties with an emphasis on conceptual problems. Kinetics, gas phase and acid base equilibria, electrochemistry, selected topics in the chemistry of metallic and nonmetallic elements, and organic molecules. The 163, 164 sequence does not meet the prerequisite for 331. Credit by examination (test-out exams) for 163, 164, 167, 177, and 178 is available only to students who are not currently enrolled in the course. Only one of 164 and 178 may be counted toward graduation.

Chem 164L. Laboratory in General Chemistry. (0-3) Cr. 1. F.S. *Prereq:* 163L and previous credit or enrollment for credit in 164. Laboratory to accompany 164. 164L is not a necessary corequisite with 164. Materials fee. Only one of 164L and 178L may be counted toward graduation.

Chem 165. Foundations of Chemistry for Engineers. (4-0) Cr. 4. S. *Prereq:* 155. Continuation of 155. Principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. Chem 165 or 167 satisfies the chemistry requirement in engineering curricula. Credit may not be applied toward graduation for both Chem 160 and another chemistry course. Only one of 163, 165, 167, and 177 may be counted toward graduation. Only one of 155, 163, 167, and 177 may be counted toward graduation.

Chem 167. General Chemistry for Engineering Students. (4-0) Cr. 4. F.S. *Prereq:* Math 140 or the high school equivalent and one year of traditional college prep chemistry or Chem 50. Principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. This is an accelerated course designed for students with an excellent preparation in math and science and is a terminal course intended for engineering students who do not plan to take additional courses in chemistry. Credit may not be applied toward graduation for both 160 and another chemistry course. Only one of 163, 165, 167, and 177 may be counted toward graduation. Only one of 155, 163, 167, and 177 may be counted toward graduation. Credit by examination (test-out exams) for 163, 164, 167, 177, and 178 is available only to students who are not currently enrolled in the course.

Chem 167L. Laboratory in General Chemistry for Engineering. (0-3) Cr. 1. F.S. *Prereq:* Previous credit or enrollment for credit in 167 or 165. Laboratory to accompany 167. Materials fee. Only one of 163L, 167L, and 177L may be counted toward graduation.

Chem 177. General Chemistry. (4-0) Cr. 4. F.S.SS. *Prereq:* Math 140 or high school equivalent and 50, 155 or 1 year high school chemistry and credit or enrollment in 177L. 177M: For chemistry and biochemistry majors. The first semester of a two semester sequence which explores chemistry at a greater depth and with more emphasis on concepts, problems, and calculations than 163-164. Recommended for physical and biological science majors, chemical engineering majors, and all others intending to take 300-level chemistry courses. Principles and quantitative relationships, stoichiometry, chemical equilibrium, acid-base chemistry, thermochemistry, rates and mechanism of reactions, changes of state, solution behavior, atomic structure, periodic relationships, chemical bonding. Credit may not be applied toward graduation for both 160 and another chemistry course. Only one of 163, 165, 167 or 177 may be counted toward graduation. Only one of 155, 163, 167, and 177 may be counted toward graduation. Credit by examination (test-out exams) for 163, 164, 167, 177, and 178 is available only to students who are not currently enrolled in the course.

Chem 177L. Laboratory in General Chemistry. (0-3) Cr. 1. F.S.SS. *Prereq:* Previous credit or enrollment for credit in 177. Laboratory to accompany 177. 177L must be taken with 177. 177N: For chemistry and biochemistry majors. Materials fee. Only one of 163L, 167L, and 177L may be counted toward graduation.

Chem 178. General Chemistry. (3-0) Cr. 3. F.S. *Prereq:* 177, 177L. Continuation of 177. Recommended for physical or biological science majors, chemical engineering majors, and all others intending to take 300-level chemistry courses. 178M: For chemistry and biochemistry majors. Electrochemistry, acid-base equilibria, thermodynamics, nuclear chemistry, and descriptive topics (non-metals, transition metals, coordination compounds, organic compounds, polymers, biological molecules). Only one of 164 and 178 may be counted toward graduation. Credit by examination (test-out exams) for 163, 164, 167, 177, and 178 is available only to students who are not currently enrolled in the course.

Chem 178L. Laboratory in General Chemistry. (0-3) Cr. 1. F.S. *Prereq:* 177L and previous credit or enrollment for credit in 178. Laboratory to accompany 178. 178L is not a necessary corequisite with 178.

Materials fee. Only one of 164L and 178L may be counted toward graduation.

Chem 210. Quantitative Analysis. (2-0) Cr. 2. S. *Prereq:* 177, 177L or 167 and 167L, *credit or enrollment in 178, and concurrent enrollment in 211L.* Theory and practice of elementary volumetric, chromatographic, electrochemical and spectrometric methods of analysis. Chemical equilibrium, sampling, and data evaluation. For chemistry and biochemistry majors and other students seeking a strong emphasis in chemistry. Materials fee. Only one of 210 and 211 may be counted toward graduation.

Chem 211. Quantitative and Environmental Analysis. (2-0) Cr. 2. F.S. *Prereq:* 164 and 164L or *credit or enrollment in 178; and concurrent enrollment in 211L.* Theory and practice of elementary volumetric, chromatographic, and electrochemical and spectrometric methods of analysis. Chemical equilibrium, sampling, and data evaluation. Emphasis on environmental analytical chemistry; the same methods are widely used in biological and materials sciences as well. Chemistry and biochemistry majors and students seeking a strong emphasis in chemistry should elect Chem 210. Materials fee. Only one of 210 and 211 may be counted toward graduation.

Chem 211L. Quantitative and Environmental Analysis Laboratory. (0-6) Cr. 2. F.S. *Prereq:* *Credit or enrollment in 164 and 164L, or 178; and concurrent enrollment in Chem 210 or 211.* Introductory laboratory experience in volumetric, spectrometric, electrochemical and chromatographic methods of chemical analysis. Materials fee.

Chem 231. Elementary Organic Chemistry. (3-0) Cr. 3. F.S.SS. *Prereq:* 163, 163L; *credit or enrollment in 231L.* A survey of modern organic chemistry including nomenclature, structure and bonding, and reactions of hydrocarbons and important classes of natural and synthetic organic compounds. For students desiring only an elementary course in organic chemistry. Students in physical or biological sciences and premedical or preveternary curricula should take the full year sequence 331 and 332 (with the accompanying laboratories 331L and 332L). Only one of 231 and Chem 331 or BBMB 221 may be counted toward graduation.

Chem 231L. Laboratory in Elementary Organic Chemistry. (0-3) Cr. 1. F.S.SS. *Prereq:* *Previous credit or enrollment for credit in 231.* Laboratory to accompany 231. 231L must be taken with 231. Materials fee.

Chem 298. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Chem 299. Undergraduate Research (for Freshmen and Sophomores). Cr. var. *Prereq:* *Permission of staff member with whom student proposes to work.*

Chem 301. Inorganic Chemistry. (2-0) Cr. 2. S. *Prereq:* 321. Atomic and molecular structure and bonding principles; molecular shapes and symmetry; acids and bases; solid-state structures and properties; inorganic chemistry of H, B, C. Nonmajor graduate credit.

Chem 316. Instrumental Methods of Chemical Analysis. (2-0) Cr. 2. F. *Prereq:* 210 or 211. 211L, *concurrent enrollment in 316L, Math 166, Phys 222 recommended.* Quantitative and qualitative instrumental analysis. Operational theory of instruments, atomic and molecular absorption and emission spectroscopy, electroanalysis, mass spectrometry, liquid and gas chromatography, electrophoresis, literature of chemical analysis. Nonmajor graduate credit.

Chem 316L. Instrumental Analysis Laboratory. (0-6) Cr. 2. F. *Prereq:* *Credit or enrollment in Chem 316.* Advanced laboratory experience in UV-visible spectrophotometry, atomic absorption and emission spectrometry, electrochemistry, gas and liquid chromatography, electrophoresis, mass spectrometry, and other instrumental methods. Materials fee. Nonmajor graduate credit.

Chem 321. Physical Chemistry I. (3-0) Cr. 3. F.S. *Prereq:* 178, *Math 166, Phys 222 recommended.* Classical thermodynamics 1st, 2nd, and 3rd laws with applications to gases and interfacial systems, multicomponent, multiphase equilibrium of reacting systems, surface chemistry, and electrochemical cells. Nonmajor graduate credit.

Chem 321L. Laboratory in Physical Chemistry for Engineers. (1-3) Cr. 2. S. *Prereq:* *Previous credit or enrollment for credit in 321.* Error analysis; use of computer; thermodynamics of gases; transport properties; thermochemistry; thermodynamics of phase equilibrium; chemical kinetics; polymers; mass spectrometry. Only one of 321L and 322L may be counted toward graduation. Materials fee. Nonmajor graduate credit.

Chem 322. Physical Chemistry II. (3-0) Cr. 3. F.S. *Prereq:* *Chem 321.* Kinetic theory of gases; transport properties, chemical kinetics; quantum mechanics, atomic and molecular structure, spectroscopy, statistical thermodynamics, solids. Nonmajor graduate credit.

Chem 322L. Laboratory in Physical Chemistry. (1-6) Cr. 3. S. *Prereq:* *Previous credit or enrollment for credit in 322.* Error analysis; use of computer; thermodynamics of gases; transport properties; thermochemistry; thermodynamics of phase equilibrium; chemical kinetics; polymers; molecular spectroscopy; x-ray crystallography; nuclear chemistry; surface chemistry; mass spectrometry. Materials fee. Only one of 321L and 322L may be counted toward graduation.

Chem 331. Organic Chemistry. (3-0) Cr. 3. F.S. *Prereq:* 178, *enrollment in 331L highly recommended.* The first half of a two semester sequence. Modern organic chemistry including nomenclature, synthesis, structure and bonding, reaction mechanisms. For students majoring in physical and biological sciences, premedical and preveternary curricula, chemistry and biochemistry. Students desiring only one semester of organic chemistry should take 231 and 231L, not 331. Only one of 231 and 331 may be counted toward graduation. Nonmajor graduate credit.

Chem 331L. Laboratory in Organic Chemistry. (0-3) Cr. 1. F.S. *Prereq:* *Previous credit or enrollment for credit in 331.* Laboratory to accompany 331. Materials fee.

Chem 332. Organic Chemistry. (3-0) Cr. 3. F.S.; 332M: S. *Prereq:* 331, *enrollment in 332L highly recommended.* Continuation of 331. Modern organic chemistry including nomenclature, synthesis, structure and bonding, reaction mechanisms, natural products, carbohydrates and proteins. For students majoring in physical and biological sciences, premedical and preveternary curricula, chemistry and biochemistry. 332M: For chemistry and biochemistry majors. Nonmajor graduate credit.

Chem 332L. Laboratory in Organic Chemistry. (0-3) Cr. 1. F.S. *Prereq:* 331L, *previous credit or enrollment for credit in 332.* Laboratory to accompany 332. Materials fee.

Chem 333L. Laboratory in Organic Chemistry. (0-6) Cr. 2. F. *Prereq:* *Previous credit or enrollment for credit in 331.* Laboratory to accompany 331 for chemistry and biochemistry majors. Materials fee.

Chem 334L. Laboratory in Organic Chemistry. (0-6) Cr. 2. S. *Prereq:* 333L, *previous credit or enrollment for credit in 332.* Laboratory to accompany 332 for chemistry and biochemistry majors. Materials fee.

Chem 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Chem 399. Undergraduate Research. Cr. var. *Prereq:* *Permission of staff member with whom student proposes to work and junior or senior classification.* No more than six total credits of Chem 399 and Chem 499 may be counted toward graduation.

Chem 401L. Inorganic Chemistry Laboratory. (0-4) Cr. 2. F. *Prereq:* 301. Preparation and characterization of inorganic and organometallic compounds by modern techniques. For students majoring in chemistry or biochemistry. Materials fee. Nonmajor graduate credit.

Chem 402. Inorganic Chemistry. (3-0) Cr. 3. F. *Prereq:* 301; 331 *recommended.* Chemistry of the d and f metals. Structure, bonding, electronic spectra, and reaction mechanisms. Aspects of organometallic solid state and biorganic chemistry. Nonmajor graduate credit.

Chem 470. Structure and Bonding. (Dual-listed with 570.) (2-0) Cr. 2. Alt. F., offered 1999. *Prereq:* 301, 322. Systematic development of orbital concepts for electronic structures in general molecular systems. Explanation and prediction of chemical bonding patterns and molecular properties on the basis of such electronic structures. Applications to various classes of inorganic and organic molecules.

Chem 490. Independent Study. Cr. var. *Prereq:* *Completion of 6 credits in chemistry at the 300 level or higher and permission of instructor. No more than 9 credits of Chem 490 may be counted toward graduation.*

Chem 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Chem 499. Senior Research. (0-6 or 0-9) Cr. 2 or 3 each time taken. *Prereq:* *Permission of staff member with whom student proposes to work; B average in all chemistry, physics, and mathematics courses.* Research in chosen area of chemistry, with final written report as senior thesis. This course should be elected for two consecutive semesters. For students majoring in chemistry. No more than six total credits for Chem 399 and 499 may be counted toward graduation.

Courses Primarily for Graduate Students, open to qualified undergraduate students

Chem 500. Advanced Inorganic Chemistry. (2-0) Cr. 2. F. *Prereq:* 301. Concepts of structure, bonding, and chemical reactivity applied to inorganic compounds of the metallic and nonmetallic elements. For students not majoring in inorganic chemistry.

Chem 501. Inorganic Preparations. (0-4) Cr. 2. F. *Prereq:* 402. Preparation and characterization of inorganic and organometallic compounds by modern research techniques. Materials fee.

Chem 503. Bioinorganic Chemistry. (Same as BBMB 503.) (2-0) Cr. 2. Alt. S., offered 2001. *Prereq:* 402 or BBMB 405. Essential elements; transport and storage of ions and of O₂; metalloenzymes and metallocoenzymes; electron-transfer processes in respiration and photosynthesis; metabolism of nonmetals and redox processes involved in it; medicinal aspects of inorganic chemistry.

Chem 505. Physical Inorganic Chemistry. (3-0) Cr. 3. F. *Prereq:* 402 and 322. Elementary group theory and molecular orbital theory applied to inorganic chemistry. Spectroscopic methods of characterization of inorganic compounds and organometallic compounds.

Chem 506. Systematic Inorganic Chemistry. (3-0) Cr. 3. S. *Prereq:* 402 or 500 and 322. Principles of structure and reactivity in inorganic chemistry. Descriptive chemistry of the chemical elements and their compounds.

Chem 510. Advanced Survey of Analytical Chemistry. (2-0) Cr. 2. F. *Prereq:* 316 and 316L. Selected topics in modern quantitative analysis including analytical separations, titrimetry, spectroscopy, and other instrumental methods.

Chem 511. Advanced Quantitative Analysis. (3-0) Cr. 3. S. *Prereq:* 316 and 316L. General methods of quantitative inorganic and organic analysis. Aqueous and nonaqueous titrimetry; selective reagents; sampling and sample dissolution; modern instrumenta-

tion; data evaluation; chemometrics; and analytical literature.

Chem 512. Electrochemical Methods of Analysis. (3-0) Cr. 3. F. *Prereq:* 316 and 316L, 322, and 322L. Principles of convective-diffusional mass transport in electroanalysis. Applications of potentiometry, voltammetry, and coulometry. Introduction to heterogeneous and homogeneous kinetics in electroanalysis. Analog and digital circuitry. Interfacing.

Chem 513. Analytical Molecular and Atomic Spectroscopy. (3-0) Cr. 3. S. *Prereq:* 316 and 316L, 322, 322L. Introduction to physical optics and design of photometric instruments. Principles of absorption, emission, fluorescence, and Raman spectroscopy. Error and precision of optical methods. Ultraviolet, visible, and infrared methods of qualitative and quantitative organic and inorganic analysis.

Chem 516. Analytical Separations. (3-0) Cr. 3. F. *Prereq:* 316 and 316L, 322, 322L. Principles and examples of inorganic and organic separation methods applied to analytical chemistry. Solvent extraction, volatilization, ion exchange, liquid and gas chromatography, and electrophoresis.

Chem 530. Advanced Organic Chemistry. (2-0) Cr. 2. S. *Prereq:* 332. Selected topics in modern organic chemistry, including structure, reaction mechanisms, organic synthesis and spectroscopy. For students not majoring in organic chemistry.

Chem 531. Organic Synthesis I. (2-0) Cr. 2. S. *Prereq:* 332. Survey of organic functional group transformations.

Chem 532. Organic Synthesis II. (2-0) Cr. 2. F. *Prereq:* 531. Synthesis of complex organic compounds including natural products.

Chem 537. Physical Organic Chemistry I. (3-0) Cr. 3. F. *Prereq:* 332. Molecular structure, stereochemistry, introduction to reaction mechanisms, thermodynamic and kinetic data, linear free energy relationships, isotope effects, orbital symmetry.

Chem 538. Physical Organic Chemistry II. (3-0) Cr. 3. S. *Prereq:* 537. Survey of reactive intermediates including cations, anions, carbenes, and radicals.

Chem 550. Safety in the Chemical Laboratory. (1-0) Cr. 1. F. *Prereq:* 332L or equivalent. Introduction to laboratory safety and chemical hygiene. Use of engineering controls and personal protective equipment. Chemical storage and waste disposal practices. Handling hazardous chemicals. Radiation safety and laser safety. Offered on a satisfactory-fail grading basis only.

Chem 555. Chemical Pedagogy. (1-0) Cr. 1. F.S.SS. *Prereq:* Graduate teaching assistantship in chemistry. Policies, methods of instruction, and practice teaching in undergraduate chemistry recitation, discussion, and laboratory courses for chemistry graduate teaching assistants. Offered on a satisfactory-fail grading basis only.

Chem 560. Advanced Physical Chemistry. (2-0) Cr. 2. S. *Prereq:* 322. Principles of physical chemistry as they apply to analytical, inorganic, and organic chemistry, including thermodynamics, kinetics, quantum mechanics and spectroscopy. For students not majoring in physical chemistry.

Chem 561. Fundamentals of Quantum Mechanics. (4-0) Cr. 4. F. *Prereq:* 322. Schrödinger equation and exact solutions; square wells and barriers; harmonic oscillator; the hydrogen atom; atomic orbitals; operators including angular momenta; time-independent and time-dependent perturbation theory; Schrödinger and Heisenberg representations; unitary operators; interaction picture, density matrix.

Chem 562. Fundamentals of Atomic and Molecular Quantum Mechanics. (3-0) Cr. 3. S. *Prereq:* 561, credit or enrollment in 583. Variational method, many electron atoms; addition of angular momentum, self-consistent field method for open and closed shells, linear combinations of atomic orbitals, origin of chemical bonding, many-electron diatomic and polyatomic molecules, treatments of electron correlation, approximation methods.

Chem 563. Statistical Mechanics. (2-0) Cr. 2. S. *Prereq:* 322. Microscopic and macroscopic proper-

ties, laws of thermodynamics, ensembles and distribution functions, applications to gases, solids, and chemical equilibrium.

Chem 564. Molecular Spectroscopy and Structure. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 505 or 562. Maxwell's field equations, interaction of light with matter including time-dependent perturbation theory, microwave, vibrational (infra-red, Raman) and electronic spectroscopies, symmetry derived selection rules, special lineshapes and introduction to nonlinear and coherent laser spectroscopies.

Chem 570. Structure and Bonding. (Dual-listed with 470.) (2-0) Cr. 2. Alt. F., offered 1999. *Prereq:* 301, 322. Systematic development of orbital concepts for electronic structures in general molecular systems. Explanation and prediction of chemical bonding patterns and molecular properties on the basis of such electronic structures. Applications to various classes of inorganic and organic molecules.

Chem 571. Solid State Chemistry. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 301, 322. A study of solid state materials including structures, bonding, defects, disorder, phase transitions, ionic mobility, metal-insulator transitions, band theory, synthesis and intercalation.

Chem 572. Spectrometric Identification of Organic Compounds. (2-3) Cr. 3. F. *Prereq:* 332. Principles of infrared, ultraviolet, nuclear magnetic resonance, and mass spectroscopy as applied to organic chemistry.

Chem 573. Classical Thermodynamics. (2-0) Cr. 2. Alt. F., offered 2000. *Prereq:* 322. The laws of thermodynamics and their applications to single and multi-component systems, heterogeneous and homogeneous equilibria, properties of gases, condensed phases, solutions, and surfaces.

Chem 574. Organometallic Chemistry of the Transition Metals. (2-0) Cr. 2. Alt. S., offered 2000. *Prereq:* 301, 332. Transition metal complexes of ligands such as cyclopentadienyl, olefins, acetylenes, benzenes, and carbon monoxide. Homogeneous catalysis.

Chem 575. Diffraction and Crystal Structure. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 322. Crystal and molecular structure determination. Data collection techniques, space group symmetry, application of Fourier methods, methods of phasing structural amplitudes.

Chem 576. Surface Chemistry. (3-0) Cr. 3. F. *Prereq:* 322. Gas-surface interactions and techniques of characterization. Idealized surface lattices, surface tension, Wulff plots, work function, adsorbate-adsorbate interactions, 2D phase diagrams, diffusion, thin film growth, adsorption and desorption mechanisms/energetics/kinetics, adsorption isotherms, vacuum techniques, electron- and ion-based spectroscopies for surface analysis (including AES, FIM, XPS, UPS, EXAFS, EELS, SIMS, LEED and STM).

Chem 577. Mass Spectrometry. (2-0) Cr. 2. Alt. F., offered 1999. *Prereq:* Permission of instructor. Basic physics, instrumentation, and chemical applications of mass spectrometry.

Chem 578. Chemical Kinetics and Mechanisms. (2-0) Cr. 2. Alt. F., offered 2000. *Prereq:* 322. Rates and mechanisms; reversible, consecutive, and competing reactions; chain mechanisms; kinetic isotope effects; very rapid reactions; acid-base catalysis, theories of unimolecular reactions; transition state and Marcus theories.

Chem 579. Introduction to Research in Chemistry. (1-0) Cr. R. F.S. Introduction to the various areas of research in chemistry at Iowa State University.

Chem 580. Introduction to Computational Quantum Chemistry. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 322. Basic principles of quantum mechanics, schrodinger equation. Hartree-Fock/molecular orbital theory, introduction to group theory, introduction to modern methods of computational chemistry; applications include molecular structure, potential energy surfaces and their relation to chemical reactions; molecular spectroscopy and photochemistry.

Chem 581. Principles of Lasers and Optics. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 322, Phys 222.

Students with weak background should take Chem 580. For students working with lasers and optics; stimulated adsorption and emission based on the classical electron oscillator model; population inversion, laser amplification; laser pumping; oscillation and cavity modes; laser beam characterization; linear propagation; design of laser resonators, ray and wave optics; nonlinear optics.

Chem 582. Computer Solutions to Chemical Problems. (1-3) Cr. 2. S. *Prereq:* 316 and 316L, Phys 222 and basic knowledge of computers. Computer interfacing and control of chemical measurements. Signal transducers, analog and digital circuits, data domains and data conversion, evaluation of data. Independent project involving computer control of a chemical experiment.

Chem 583. Chemical Group Theory. (1-0) Cr. 1. F. *Prereq:* 322. Basic concepts and theorems, representation theory; point groups, molecular orbitals, molecular states, molecular vibrations, rotation group and angular momenta; space groups and crystals; permutation group, antisymmetry, and spin states.

Chem 589. Current Topics in Chemistry. (1-0) Cr. R. F.S. Presentation of recent literature and chemical problems under current investigation.

Chem 599. Nonthesis Research. Cr. arr. *Prereq:* Permission of staff member concerned.

Courses for Graduate Students

Chem 600. Seminar in Inorganic Chemistry. (1-0) Cr. 1 each time taken. F.S. *Prereq:* Permission of instructor.

Chem 601. Selected Topics in Inorganic Chemistry. (1-0 or 2-0) Cr. 1 or 2. F.S. *Prereq:* Permission of instructor. Topics such as molecular structure and bonding; organometallic compounds; physical techniques of structure determination; non-aqueous solutions; Zintl phases; transition-metal oxides; free-radical reactions; electron transfer reactions; metal-metal bonding; and bioinorganic chemistry of nucleic acids.

Chem 611. Seminar in Analytical Chemistry. (1-0) Cr. 1 each time taken. F.S. *Prereq:* Permission of instructor.

Chem 619. Special Topics in Analytical Chemistry. (2-0) Cr. 2 each time taken. F.S. *Prereq:* Permission of instructor. Raman spectroscopy, sensors, spectro-electrochemistry, capillary electrophoresis, analytical plasmas, chemometrics and bioanalytical chemistry.

Chem 631. Seminar in Organic Chemistry. (1-0) Cr. 1 each time taken. F.S. *Prereq:* Permission of instructor.

Chem 632. Selected Topics in Organic Chemistry. (1-0) Cr. 1 each time taken. F.S. *Prereq:* 537. Topics of current interest in organic chemistry such as spectroscopy, physical organic chemistry, photochemistry, organometallic chemistry, mechanisms of oxidations and reductions, modern organic synthesis, and reactive intermediates.

Chem 660. Seminar in Physical Chemistry. (1-0) Cr. 1 each time taken. S. *Prereq:* Permission of instructor.

Chem 667. Special Topics in Physical Chemistry. (1-0) or (2-0) Cr. 1 or 2. F.S. *Prereq:* Permission of instructor. Advanced and recent developments in experimental physical chemistry are selected for each offering.

Chem 699. Research. *Prereq:* Permission of staff member concerned.

Civil Engineering

(Administered by the Department of Civil and Construction Engineering)

Lowell F. Greimann, Chair of Department

Distinguished Professors: Klaiber

University Professors: Austin

Professors: Bergeson, Brewer, Fanous, Greimann, Jeyapalan, Kannel, Kao, Lohnes, Maze, Northup, Oulman, Porter, Wipf

Distinguished Professors (Emeritus): Baumann, Cleasby, Handy

Professors (Emeritus): Carstens, Ekberg, Hardy, Jellinger, Lee, Mashaw, Mickle, Morgan, Patterson, Ring, Sanders

Associate Professors: Abendroth, Baenziger, Cable, Dunker, Federle, Jaselskis, Jones, Mercier, Pitt, Rowings, Smith, Souleyrette

Associate Professors (Collaborators): Dutta

Associate Professors (Emeritus): Chase, Sheeler, Ward

Assistant Professors: Bolluyt, Coree, Ellis, Gu, Jahren, Kjartanson, Knapp, Ong, Sung

Assistant Professors (Adjunct): Kamyab, Schlorholtz

Assistant Professors (Collaborators): Golchin

Instructors (Adjunct): Amenson, Gaunt

Undergraduate Study

For undergraduate curriculum in civil engineering leading to the degree bachelor of science, see *College of Engineering, Curricula*. This curriculum is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

Civil engineering consists of the economic application of the laws, forces, and materials of nature to the planning, design, construction, maintenance, and operation of public and private facilities. Commonly included are transportation systems; bridges and buildings; water supply, pollution control, irrigation, and drainage systems; river and harbor improvements; dams and reservoirs. Civil engineering also includes the planning, design, and responsible execution of surveying operations, and the location, delimitation, and delineation of physical and cultural features on the surface of the earth. Research, testing, sales, management, and related functions are also a part of civil engineering. Work on the campus is supplemented by inspection trips which furnish an opportunity for firsthand study of engineering systems in operation, as well as projects under construction.

Because of the widespread use of microcomputers throughout civil engineering practice, the department has incorporated microcomputer applications into many of the civil engineering courses.

Program Goal

Consultation with an industrial advisory board of employers of civil engineers, with a broad base of civil engineering educators, and with students and alumni has yielded a continuous process of program planning, program assessment, curriculum development, and instructional development to produce an integrated, learning-based curriculum. The curriculum listed in this bulletin has the academic program goal of developing an effective program that fulfills student educational needs and that equips and empowers qualified students for a successful career in Civil Engineering.

Program Objectives

Program objectives and related outcomes intended to proceed toward achievement of the program goal above include the following.

1. Design, coordinate, and execute an integrated undergraduate Civil Engineering program that produced graduates who
 - have a fundamental understanding of mathematics, statistics, and physical sciences, and where appropriate, life sciences;
 - have a broad base of knowledge in civil engineering technical areas, represented by the transportation and surveying, the structural, the environmental and water resources, and geotechnical and materials disciplinary areas;
 - have a basic understanding of cost estimating, planning and scheduling for civil engineering projects;
 - utilize critical thinking to identify, define and develop alternate solutions, and to implement a feasible design to solve an open-ended or ill-defined problem while considering constructability, sustainability and maintainability of the design;
 - are effective in oral, written and graphical communication of ideas to engineers and non-engineers;
 - recognize and understand the importance of timely and effective communication during the design and construction process;
 - have an ability to effectively use computers as a tool for communication, problem solving, analysis and design;
 - have an ability to work effectively within a multi-disciplinary team;
 - recognize and understand the importance and necessity for high professional and ethical standards;
 - have a basic knowledge of business and management principles and practices;
 - have an understanding of social, political and cultural issues, and
 - have an ability to design and conduct experiments as well analyze and interpret data.
2. Provide opportunities for student interaction with practicing professionals.
3. Provide opportunities for students to develop their leadership skills.
4. Encourage and motivate students for lifelong learning, continued intellectual and professional growth and professional licensure.
5. Encourage cooperative education, internships or progressive summer engineering employment.
6. Develop and maintain an academic advising system and a mentoring system that retains qualified students.
7. Develop and maintain a faculty that serves as a model of professional excellence for our students.

Continued curriculum development will expand and increase the implementation of courses and programs to support the goal and objectives listed here. This goal and these objectives are consistent with, and supportive of, the College goals and objectives (See *College of Engineering section*.)

Graduate Study

The Department of Civil and Construction

Engineering offers the master of science and doctor of philosophy degrees with a major in civil engineering with areas of specialization in structural engineering, environmental engineering, construction engineering and management, geotechnical engineering, civil engineering materials, transportation engineering, and geomechanics. The department also offers minor work to students taking major work in other engineering departments.

Candidates for the degree master of science are required to satisfactorily complete 30 credits of acceptable graduate work, including preparation of a thesis or the completion of a creative component in lieu of a thesis.

The normal prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of engineering students at this university. However, because of the diversity of interests within the graduate programs in civil engineering, a student may qualify for graduate study even though undergraduate or prior graduate training has been in a discipline other than engineering. Supporting work will be required depending upon the student's background and area of interest. A prospective graduate student is urged to specify the degree program in which he or she is interested on the application for admission.

The department participates in the interdepartmental majors in transportation (M.S. only), and water resources (see *Index*).

Courses open for nonmajor graduate credit: all 300 and 400 level courses except 301, 302, 314, 383, 396, 397, 398, 401, 402, 427, 428, 429, 451, 486, 490, and 498.

Courses Primarily for Undergraduate Students

C E 102. Civil Engineering Projects. (1-0) Cr. 1. F.S. Introduction to civil engineering projects and practices. Field trip fee. Materials fee.

C E 111. Fundamentals of Surveying I. (2-3) Cr. 3. F.S. *Prereq: Math 165, Engr 101, 160, credit or enrollment in Engr 170 or C E 170, credit or enrollment in C E 102 for C E majors.* Introduction to error theory. Fundamentals of observing distances, elevations, and angles. Traversing. Irregular areas. Circular and parabolic curves. Earthwork including mass diagrams. Construction staking. Computer applications. Materials fee.

C E 170. Graphics for Civil Engineering. (0-4) Cr. 2. F.S. *Prereq: Math 165, credit or enrollment in 102.* Fundamental graphics. Introduction to computer aided drafting and modeling. Civil engineering applications.

C E 201. Pre-professional Experience in Civil Engineering I. (1-0) Cr. R. F. *Prereq: Sophomore standing in civil engineering.* Participation in Student Chapter of American Society of Civil Engineers programs, participation in CCE Extension Education professional development programs.

C E 202. Pre-professional Experience in Civil Engineering II. (1-0) Cr. R. S. *Prereq: Sophomore standing in civil engineering.* Participation in Student Chapter of American Society of Civil Engineers programs, participation in CCE Extension Education professional development programs. Sophomore assessment.

C E 205. Introduction to Computer Applications in Architecture. (Same as Arch 205.) (1-5) Cr. 3. F.S. *Prereq: Credit or enrollment in Arch 201.* Computer applications in architecture with an emphasis on graphics; computer hardware, software, and terminology; and introduction to the creation, manipula

tion, analysis, and storage of computer model geometry; specification writing using the computer.

C E 215. Basic Surveying. (1-3) Cr. 2. F. *Prereq: Competence in algebra and trigonometry.* Fundamentals of observing distances, elevations, and angles. Traversing. Irregular areas. Earthwork volumes. Circular and parabolic curves. Construction staking. Materials fee. Not available for graduation credit in civil or construction engineering.

C E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

C E 301. Professional Issues in Civil Engineering. (3-0) Cr. 3. F. *Prereq: 202, Sp CM 212, Engl 105, Lib 160.* Engineering ethics. Professional law and regulation. Professional liability. Team building and total quality management. Engineering business management principles. Professional practice issues.

C E 302. Professional Progress Assessment. (1-0) Cr. R. S. *Prereq: 301.* Junior assessment.

C E 314. Fundamentals of Surveying II. (2-3) Cr. 3. F. *Prereq: 111.* Triangulation. State Plane Coordinate Systems. Astronomic observation for direction. Introduction to mapping, photogrammetry, and global positioning systems. Location surveys. Introduction to land surveys. Computer applications. Materials fee.

C E 326. Principles of Environmental Engineering. (2-2) Cr. 3. F. S. *Prereq: Chem 178, Math 166, credit or enrollment in E M 378.* Introduction to environmental problems, water quality parameters and requirements, potable water quality and quantity objectives, water sources and treatment methods; water pollution control objectives and treatment methods; survey of solid and hazardous waste management and air pollution control. Materials fee. Nonmajor graduate credit.

C E 332. Structural Analysis I. (2-2) Cr. 3. F.S. *Prereq: E M 324.* Loads, shear, moment, and deflected shape diagrams for framed structures. Approximate methods. Displacement calculations. Flexibility and stiffness methods. Computer applications. Moment distribution. Influence lines and Müller-Breslau principle. Materials fee. Nonmajor graduate credit.

C E 333. Structural Steel Design I. (2-2) Cr. 3. F.S. *Prereq: 332, E M 327.* Design and behavior of the elements of steel structures, proportioning members and connections. Emphasis on load and resistance factor design and treatment of allowable stress design. Preliminary design of building frames. Materials fee. Nonmajor graduate credit.

C E 334. Reinforced Concrete Design I. (2-2) Cr. 3. F.S.SS. *Prereq: 332, E M 327.* Analysis and design of beams, one-way slabs, and columns. Preliminary design of building frames using pattern loading and moment coefficients. Materials fee. Nonmajor graduate credit.

C E 350. Introduction to Transportation Planning. (3-0) Cr. 3. S. *Prereq: 3 credits in statistics, junior classification.* Planning of urban and regional transportation systems. Applications of population, land use, economic, social, and travel studies to problems of transportation system configuration and route location. Organization and coordination of the transportation planning function. Materials fee. Not available for graduation credit for students in civil engineering. Nonmajor graduate credit.

C E 353. Introduction to Railroad Planning and Design. (2-4) Cr. 2. Half-semester course. F. *Prereq: 102, 170, 111, E M 307, Math 166, Sp Cm 212, Engl 105, Lib 160, a course in statistics.* Railroad planning and design. Operations and maintenance. Team design project. Oral and written report. Materials fee. Nonmajor graduate credit.

C E 354. Introduction to Airport Planning and Design. (2-4) Cr. 2. Half-semester course. F. *Prereq: 102, 170, 111, E M 307, Math 166, Sp Cm 212, Engl 105, Lib 160, a course in statistics.* Airport planning and design. Operations and maintenance. Team

design project. Oral and written report. Materials fee. Nonmajor graduate credit.

C E 360. Soil Engineering. (2-3) Cr. 3. F.S. *Prereq: Geol 201, E M 324.* Introduction to soil engineering and testing. Identification and classification tests, soil water systems, and interactive forces, principles of settlement, shearing stresses in soils and shear strength testing; embankments, retaining walls, foundations. Materials fee. Nonmajor graduate credit.

C E 372. Engineering Hydrology and Hydraulics. (2-4) Cr. 4. F. S. *Prereq: E M 378, Math 273, a course in statistics from approved department list.* The hydrologic cycle: precipitation, infiltration, runoff, evapotranspiration, groundwater, and streamflow. Hydrograph analysis, flood routing, frequency analysis and urban hydrology. Applied hydraulics including pipe and channel flow with design applications in culverts, pumping, water distribution, storm and sanitary sewer systems. Design project required. Materials fee. Nonmajor graduate credit.

C E 382. Design of Concretes and Pavement Structures. (1-6) Cr. 3. F.S. *Prereq: 360.* Physical and chemical properties of bituminous, portland, and other cements; aggregate properties and blending; mix design and testing of concretes; admixtures, mixing, handling, placing and curing; pavement thickness design. Materials fee. Nonmajor graduate credit.

C E 383. Design of Portland Cement Concrete. (0-2) Cr. 1. F.S. *Prereq: 360. For Con E students only.* Physical and chemical properties of portland cement and p.c. concrete. Mix design and testing of p.c. concrete. Materials fee.

C E 396. Summer Internship for International Students. Cr. R. SS. *Prereq: Permission of department chair, completion of two terms in residence in civil engineering, employment in civil engineering or related field.* Summer professional work period for international students.

C E 397. Engineering Internship. Cr. R. F.S. *Prereq: Permission of department chair.* One semester maximum per academic year professional work period.

C E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

C E 401. Professional Technical Outcomes Assessment. (1-0) Cr. 1. F.S. *Prereq: 301, credit or enrollment in 302, senior classification in civil engineering.* Civil engineering curriculum disciplinary topics related to the Fundamentals of Engineering examination. Eight-hour examination. Materials fee.

C E 402. Professional Continuing Development. (1-0) Cr. 1. F.S. *Prereq: Credit or enrollment in 401, senior classification in civil engineering.* Curriculum goals and objectives assessment. Focus groups. Participation in CCE Extension Education professional development program. Continuing professional competence requirements.

C E 417. Land Surveying. (2-3) Cr. 3. S. *Prereq: 111.* Legal principles affecting the determination of land boundaries, public domain survey systems. Locating sequential and simultaneous conveyances. Record research, plat preparation, and land description. Study of selected court cases. Materials fee. Nonmajor graduate credit.

C E 427. Environmental Engineering Science. (2-2) Cr. 3. F.S. *Prereq: Chem 167 or 177.* Physical, chemical and biological principles related to environmental engineering management including water chemistry, environmental reactions and kinetics, mass transfer principles, and description of microbial degradation and processes in the environment. Materials fee.

C E 428. Water and Wastewater Treatment Processes. (2-3) Cr. 3. S. *Prereq: 326, 427.* Physical, chemical and biological processes for the treatment of water and wastewater including air stripping, coagulation and flocculation, sedimentation, filtration, adsorption, chemical oxidation/disinfection, fixed film and suspended growth biological processes and sludge management. Materials fee.

C E 429. Environmental Systems Engineering. (2-3) Cr. 3. F. *Prereq: 326, 427.* Fate, distribution, interactions, and transport of pollutants on land, air and water resources. Includes air, water and solid/hazardous waste management; reaction processes in natural systems; and modeling.

C E 446. Bridge Design. (2-2) Cr. 3. Alt. S., offered 2001. *Prereq: 333, 334.* Bridge design in structural steel and reinforced concrete. Application of AASHTO Bridge Design Specifications. Analysis techniques for complex structures. Preliminary designs include investigating alternative structural systems and materials. Final designs include preparation of design calculations and sketches. Materials fee. Nonmajor graduate credit.

C E 447. Building Design. (2-2) Cr. 3. Alt. S., offered 2000. *Prereq: 333, 334.* Building design in structural steel and reinforced concrete. Investigation of structural behavior of frameworks. Lateral load resisting systems. Application of current building codes and design specifications. Review of building designs. Preliminary designs include investigating alternative structural systems. Final designs include preparation of design calculations and sketches. Materials fee. Nonmajor graduate credit.

C E 451. Urban Transportation Planning and Management. (Dual-listed with 551.) (2-3) Cr. 3. F. *Prereq: 350 or 353 or 354 or 453.* Planning of highway systems and terminals as part of a complete planning approach; public transportation system planning; transportation planning studies, projections analysis, plan formulation, and programming. Transportation system management models, concepts, and methods. Individual and group projects. Materials fee.

C E 453. Highway Design. (3-3) Cr. 4. F.S. *Prereq: 111, Engl 314, E M 307, a course in statistics, 372, 382, I E 304.* Introduction to traffic engineering and highway planning. Design, construction, and maintenance of highway facilities; earthwork, drainage structures; pavements. Preparation of environmental impact statement. A complete design project is required. Materials fee. Nonmajor graduate credit.

C E 460. Foundations. (3-0) Cr. 3. F.S. *Prereq: 360.* Fundamentals of foundation engineering. Exploration, sampling, and in-situ tests. Shallow and deep foundations. Settlement and bearing capacity analyses. Stability of excavations and earth retaining structures. Materials fee. Nonmajor graduate credit.

C E 473. Groundwater Hydrology. (Dual-listed with 573.) (3-0) Cr. 3. F. *Prereq: 372.* Principles of groundwater flow, hydraulics of wells, super-position, slug and pumping tests, streamlines and flownets, and regional groundwater flow. Contaminant transport. Computer modeling. Materials fee. Nonmajor graduate credit.

C E 486. Engineering Design. (2-2) Cr. 3. F.S. *Prereq: 301, 326, 333 or 334, 382, credit or enrollment in 429 or 453, Engl 314, Sp Cm 212.* The engineering design process, case histories of design inadequacies, environmental impact, safety and health in the work place, cost estimating, planning and scheduling, and synthesis of previous coursework using a group project. Materials fee.

C E 490. Independent Study. By conference. Cr. 1 to 6. F.S. *Prereq: Permission of instructor.* Independent study in any phase of civil engineering. Pre-enrollment contract required.
H. Honors

C E 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, open to qualified undergraduate students

C E 501. Preconstruction Project Engineering and Management. (3-0) Cr. 3. *Prereq: Con E 221 and 441.* Application of engineering and management control techniques to construction project development from conceptualization to notice to proceed. Determinants of construction project success, con-

ceptual estimating, design and engineering planning for automated construction techniques, constructability review procedures, planning for safety, value engineering. Field trip fee. Materials fee.

C E 502. Construction Project Engineering and Management. (3-0) Cr. 3. F. 2000. *Prereq:* *Con E 221 and 441*. Application of engineering and management control techniques to construction projects. Construction project control techniques, equipment selection and utilization, project administration, construction process simulation, TQM, and productivity improvement programs. Field trip fee. Materials fee.

C E 503. Construction Management Functions and Processes. (3-0) Cr. 3. S. 2000. *Prereq:* *Con E 421*. Analysis of critical construction management skills. Analysis of organizational systems related to construction management. Case studies. Analysis of theories of motivation, planning, leadership, organizational change, etc., as they relate to field construction operations. Materials fee.

C E 504. Construction Quality Management. (3-0) Cr. 3. *Prereq:* *Con E 22 and 421*. Leading theory and principles of quality management and their application to the construction industry. Development of numerical measures for construction processes. Application of formalized problem-solving techniques in a team environment. Customer satisfaction surveys. Current practices in the construction industry. Materials fee.

C E 505. Design of Construction Systems. (3-0) Cr. 3. F. 2000. *Prereq:* *360, Con E 322 and 340*. Advanced design of concrete formwork and falsework systems. Design for excavation and marine construction including temporary retaining structures and cofferdams. Aggregate production operations, including blasting, crushing, and conveying systems. Rigging system design. Field trip fee. Materials fee.

C E 506. Case Histories in Construction Documents. (3-0) Cr. 3. *Prereq:* *Con E 221, credit or enrollment in Con E 421*. Study of cases involving disputes, claims, and responsibilities encountered by management in construction contract documents. Analysis of methods of resolving differences among the owner, architect, engineer, and construction contractor for a project. Materials fee.

C E 507. Construction Finance and Marketing. (3-0) Cr. 3. S. 2000. *Prereq:* *Con E 221, credit or enrollment in Con E 421*. Analytical concepts and methodologies from modern finance theory and practice. Project finance, cash flow analysis, foreign exchange exposure, and innovative financial methods. Construction funding processes and project development. Functions involved in marketing construction services. Need for construction marketing, market area and research, planning and objectives, operations personnel. Materials fee.

C E 510. Advanced Technologies for Construction. (3-0) Cr. 3. F. 2000. S. *Prereq:* *Con E 421, Engr 160*. Advanced technologies including microcomputer systems, management information systems, automation technologies, computer-aided design, and expert systems and their application in the construction industry. Overview of systems acquisition, communications, and networking. Materials fee.

C E 513. Geodetic and Satellite Surveying. (2-3) Cr. 3. Alt. SS., offered 2000. *Prereq:* *111*. Triangulation and trilateration observation and computation. Precise leveling. Electronic distance measuring instrument calibration. Geodetic astronomy for latitude and longitude determination. Global positioning systems of satellite observation and computation. Materials fee.

C E 515. Adjustment of Observations. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* *111, a course in statistics from approved department list*. Theory of errors. Error propagation in geodetic and photogrammetric systems. Observation and condition equations in least squares adjustment. Methods of constraint, collocation and multiquadric. Practice in the application of theory of least squares to adjustment of observations. Error analyses. Materials fee.

C E 517. Analytical Photogrammetry and Geographic Information Systems. (2-3) Cr. 3. Alt. F., offered 1999. *Prereq:* *111*. Theory and practice of

stereoplotting systems. Planning and execution of photogrammetric projects. Concepts, principles, and methods of analytical photogrammetry. Creation of digital terrain models and basemaps for geographic information systems (GIS). Use of computer aided design and GIS software. Materials fee.

C E 518. Physical and Geometric Geodesy. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* *513*. General theory of geometric and physical geodesy. Geometry of geodetic reference surfaces. Spherical and cartesian coordinate systems. Coordinate transformations. Gravity and potential theory. Theory of geoidal undulation and deflection of the vertical. Spherical harmonic series. Materials fee.

C E 519. Remote Sensing and Digital Photogrammetry. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* *517*. Electromagnetic spectrum and theoretical basis of remote sensing. Remote sensing systems including multispectral scanners, microwave and radar images. Image analysis of digital data from various databases using a variety of software packages. Observation of strips and blocks of digital data and their adjustment. Calibration of photogrammetric systems. Materials fee.

C E 520. Environmental Engineering Chemistry. (2-3) Cr. 3. F. *Prereq:* *326*. Principles of chemistry and physical phenomena applicable to the treatment of water and wastewater and to reactions receiving waters; including reaction kinetics, acid-base equilibria, chemical precipitation, redox reactions and mass transfer principles. Individual and group projects required. Materials fee.

C E 521. Environmental Biotechnology. (2-2) Cr. 3. F. *Prereq:* *326*. Fundamentals of biochemical and microbial processes applied to environmental engineering processes, role of microorganisms in wastewater treatment and bioremediation, bioenergetics and kinetics, metabolism of xenobiotic compounds, waterborne pathogens and parasites, and disinfection. Materials fee.

C E 522. Water Pollution Control Processes. (2-3) Cr. 3. S. *Prereq:* *521*. Fundamentals of biochemical processes, aerobic growth in a single CSTR, multiple events in complex systems, and techniques for evaluating kinetic parameters; unit processes of activated sludge system, attached growth systems, stabilization and aerated lagoon systems, biosolids digestion and disposal, nutrient removal, and anaerobic treatment systems. Materials fee.

C E 523. Physical-Chemical Treatment Process. (2-3) Cr. 3. S. *Prereq:* *520*. Principles and design of physical-chemical processes; including coagulation, flocculation, chemical precipitation, sedimentation, filtration, adsorption, membrane processes, ion exchange and disinfection; laboratory exercises and demonstrations. Individual and group projects required. Materials fee.

C E 526. Air Pollution Control Technology. (2-0) Cr. 2. Alt. S., offered 2000. *Prereq:* *326*. Sources, characteristics, effects, and control of air pollutant emissions from stationary and mobile sources; atmospheric chemistry and global impacts; contaminant dispersion and modeling, including meteorological and climatological aspects; control technologies for particulates, sulfur and nitrogen oxides, unburned hydrocarbons, volatile and toxic substances, and odors. Materials fee.

C E 527. Solid Waste Management. (2-0) Cr. 2. F. *Prereq:* *326*. Planning and design of solid waste management systems; includes characterization and collection of domestic, commercial, and industrial solid wastes, waste minimization and recycling, energy and materials recovery, composting, incineration, and landfill design. Materials fee.

C E 529. Hazardous Waste Management. (3-0) Cr. 3. S. *Prereq:* *520, 521*. Regulatory requirements for the classification, transport, storage and treatment of hazardous wastes. Analysis and design of alternatives for treatment and disposal technologies, including physical, chemical, and biological treatment, solidification, incineration, and secure landfill design. Regulatory requirements and procedures for hazardous waste contaminated site investigations and risk analysis. Analysis and design of remedial action alternatives for site restoration. Materials fee.

C E 532. Structural Analysis II. (3-0) Cr. 3. F. *Prereq:* *332, FORTRAN equivalent*. Displacements by virtual work, unit load. Analysis of structural problems by the force and stiffness methods. Direct stiffness method for 2-D frames, grids, 3-D frames. General purpose frame programs. Materials fee.

C E 533. Structural Steel Design II. (3-0) Cr. 3. F. *Prereq:* *333*. Development of the AISC design equations for tension members, columns, beams, beam-columns, and plate girders by LRFD and ASD methods. Elastic and inelastic buckling of members and member elements. Torsion of W-shapes. Composite design. Materials fee.

C E 534. Reinforced Concrete Design II. (2-2) Cr. 3. S. *Prereq:* *334*. Design of reinforced concrete long columns, floor slabs, building frames, isolated footings and combined footings. Design and behavior considerations for torsion, biaxial bending, structural joints and shear friction. Introduction to cold-formed composite steel and composite floor slab design. Materials fee.

C E 535. Prestressed Concrete Structures. (3-0) Cr. 3. F. *Prereq:* *334*. Design of prestressed concrete structures, review of hardware, stress calculations, prestress losses, deflections, shear design, section proportioning, special topics. Field trip fee.

C E 536. Masonry and Timber Design. (2-2) Cr. 3. F. *Prereq:* *334*. Behavior and design of clay and concrete masonry beams, columns, walls, and structural systems. Behavior and design of timber and laminated timber beams, columns, connections, and structural systems. Materials fee. Field trip fee.

C E 540. Behavior of Reinforced Concrete Structures. (3-0) Cr. 3. Alt. F., offered 2001. *Prereq:* *334*. Behavior and strength of reinforced concrete members by reviews of experimental and analytical investigations; flexure, axial load, shear, bond, torsion; combined loadings. Materials fee.

C E 541. Dynamic Analysis of Structures. (3-0) Cr. 3. S. *Prereq:* *532, E M 307 or E M 345*. Single and multi-degree of freedom systems. Free and forced vibrations. Linear and nonlinear response. Modal analysis. Response spectra. Computer programs for dynamic analysis. Seismic analysis. Materials fee.

C E 542. Structural Analysis by Finite Elements. (3-0) Cr. 3. S. *Prereq:* *532*. Use of the finite element method for the analysis of complex structural configurations. Plane stress, plate and shell finite elements. General purpose finite element programs. Materials fee.

C E 544. Limit Design and Structural Optimization. (3-0) Cr. 3. S. *Prereq:* *333, 334*. Plastic analysis and design in steel by LRFD and ASD methods. Limit analysis and design in reinforced concrete. Considerations of hinging and ductility. Structural optimization. Materials fee.

C E 547. Analysis and Design of Plate and Slab Structures. (3-0) Cr. 3. F. *Prereq:* *334, E M 514, Math 266*. Bending and buckling of thin plate components in structures utilizing classical and energy methods. Analysis of shell roofs by membrane and bending theories. Materials fee.

C E 548. Classical Analysis Methods. (3-0) Cr. 3. S. *Prereq:* *332*. Displacement computation: Moment area, conjugate beam, Newmark's method, energy methods. Extension of slope deflection and moment distribution. Introduction to cable structures, arches, frame buckling, and moving loads. Materials fee.

C E 550. Advanced Highway Design. (2-3) Cr. 3. S. *Prereq:* *453*. Rural and urban street and highway design. Establishment of design criteria, application to street and highway systems, and to interchanges and interchanges; drainage design, urban freeway design aspects. Noise analysis and other environmental factors. Materials fee.

C E 551. Urban Transportation Planning and Management. (Dual-listed with 451.) (2-3) Cr. 3. F. *Prereq:* *350 or 353 or 354 or 453*. Planning of highway systems and terminals as part of a complete planning approach; public transportation system planning; transportation planning studies, projections analysis, plan formulation, and programming.

Transportation system management models, concepts, and methods. Individual and group projects. Computer modeling and independent report. Materials fee.

C E 552. Traffic Safety, Operations, and Maintenance. (2-2) Cr. 3. Alt. S., offered 2000. *Prereq:* 353 or 354 or 453. Engineering aspects of highway traffic safety. Reduction of accident incidence and severity through highway design and traffic control. Accident analysis. Legal implications. Safety in highway design, maintenance, and operation. Materials fee.

C E 553. Traffic Engineering. (2-3) Cr. 3. F. *Prereq:* 353 or 354 or 453. Driver, pedestrian, and vehicular characteristics. Traffic characteristics; highway capacity; traffic studies and analyses. Principles of traffic control for improved highway traffic service and safety. Traffic signals, signs, and markings; lighting; channelization; other traffic control measures. Materials fee.

C E 556. Air and Public Transportation Facilities. (2-2) Cr. 3. Alt. S., offered 2001. *Prereq:* Credit or enrollment in 453 or admission to *Transportation Planning*. Airport planning and operation. Public transportation planning and terminals. Parking lots and terminals. Landside and airside aspects of air terminals. Design aspects of air and public transportation facilities. Materials fee.

C E 557. Transportation Systems Analysis. (2-3) Cr. 3. Alt. F., offered 1999. *Prereq:* 451, 3 credits in *statistics or probability*. Travel studies and analysis of data. Travel projections. Public transportation forecasts and analyses. Statewide, regional, and local transportation system planning. Corridor travel planning. Optimization of systems. Materials fee.

C E 558. Transportation Systems Development and Management Laboratory. (2-2) Cr. 3. Alt. F., offered 2000. *Prereq:* 350 or 353 or 354 or 453. Study of designated problems in traffic engineering, urban transportation planning, and urban development. Forecasting and evaluation of social, economic, and environmental impact of proposed solutions; considerations of alternatives. Formulation of recommendations and publication of a report. Presentation of recommendations in the host community. Materials fee.

C E 559. Pavement Maintenance Management. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 353 or 354 or 453, 382. Engineering management techniques for managing pavements. Systematic approach to management through pavement life cycle. Selection and scheduling of maintenance treatments. Analysis of network-wide pavement resource needs. Selection of strategies for specific pavement projects. Materials fee.

C E 560. Fundamentals of Soil Mechanics. (3-0) Cr. 3. F. *Prereq:* 360. Introduction to critical state soil mechanics, stress path limiting stress analysis, shear strength of soils under various drainage conditions, seepage, pore pressure parameters, consolidation, constitutive modeling. Materials fee.

C E 561. Applied Foundation Engineering. (2-3) Cr. 3. F. *Prereq:* 460. Lateral earth pressure theories and retaining structures. Field investigations, in-situ testing, foundations on expansive soils, and analysis and design of shallow and deep foundations. Foundation engineering reports. Field trip fee. Materials fee.

C E 562. Site Evaluations for Civil Engineering Projects. (2-2) Cr. 3. S. *Prereq:* 360. Identification and mapping of engineering soils from airphotos. Use of remote sensing and GIS, planning subsurface investigations, geomaterials prospecting, water resources applications. Materials fee.

C E 564. Application of Numerical Methods to Geotechnical Design. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 560. Application of numerical methods to analysis and design of foundations, underground structures, and soil-structure interaction. Application of slope stability software. Layered soils, bearing capacity and settlement for complex geometries, wave equation for piles, and foundation vibrations. Materials fee.

C E 565. Fundamentals of Geomaterials Behavior. (2-3) Cr. 3. F. *Prereq:* 382. Atoms and molecules, crystal chemistry, clay minerals, structure of solids, phase transformations and phase equilibria. Surfaces and interfacial phenomena, colloid chemistry, mechanical properties. Applications to soils and civil engineering materials. Overview of state-of-the-art instrumental techniques for analysis of the physico-chemical properties of soils and civil engineering materials. Materials fee.

C E 566. Applied Concretes and Pavements. (2-3) Cr. 3. S. *Prereq:* 382. Advanced portland cement and bituminous concrete (SUPERPAVE) mix designs. Aggregates. Admixtures. Production and construction, quality control and inspection. Nondestructive testing. Pavement thickness design. Materials engineering reports. Concrete and asphalt options offered alternate semesters. Materials fee. Field trip fee.

C E 567. Geomaterials Stabilization. (2-2) Cr. 3. Alt. S., offered 2001. *Prereq:* 565. Soil and aggregate physical and chemical stabilization procedures. Soil stabilization analysis and design. Ground modification methods. Geosynthetics application and design. Field trip fee. Materials fee.

C E 569. Environmental Geotechnology. (3-0) Cr. 3. S. *Prereq:* 360. Soil/water and soil/water/contaminant interaction. Geoenvironmental site investigation and site assessment technologies. Hazardous waste landfill design, construction and performance, focusing on liner and cover systems. Hazardous waste site remediation. Materials fee.

C E 570. Applied Hydraulic Design. (2-3) Cr. 3. F. *Prereq:* 372. Flow characteristics in natural and constructed channels; principles of hydraulic design of culverts, bridge waterway openings, spillways, hydraulic gates and gated structures, pumping stations, and miscellaneous water control structures; pipe networks, mathematical modeling. Design project. Materials fee.

C E 571. Surface Water Hydrology. (3-0) Cr. 3. S. *Prereq:* 372. Analysis of hydrologic data including precipitation, infiltration, evapotranspiration, direct runoff and streamflow; theory and use of frequency analysis; theory of streamflow and reservoir routing; use of deterministic and statistical hydrologic models. Fundamentals of surface water quality modeling, point and non-point sources of contamination. Design project. Materials fee.

C E 572. Analysis and Modeling Aquatic Environments. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 571. Principles of surface water flows and mixing. Introduction to hydrologic transport and water quality simulation in natural water systems. Advection, diffusion and dispersion, chemical and biologic kinetics, and water quality dynamics. Applications to temperature, dissolved oxygen, primary productivity, and other water quality problems in rivers, lakes and reservoirs. Deterministic vs. stochastic models.

C E 573. Groundwater Hydrology. (Dual-listed with 473.) (3-0) Cr. 3. F. *Prereq:* 372. Principles of groundwater flow, hydraulics of wells, super-position, slug and pumping tests, streamlines and flownets, and regional groundwater flow. Contaminant transport. Computer modeling. Individual and group projects. Materials fee.

C E 574. Environmental Impact Assessment. (3-0) Cr. 3. S. *Prereq:* 4 courses in *natural, biological or engineering sciences and senior or above classification*. Review of federal and state requirements for environmental impact assessment, requirements of the National Environmental Policy Act and Council on Environmental Quality, methods of evaluating the environmental impacts on the physical, biological, socioeconomic, cultural/historical, human health and psychological environments, public participation in EIS, review and evaluate project environmental impact statements. An environmental impact assessment of a proposed project will be completed in small teams.

C E 575. Soil and Groundwater Remediation. (3-0) Cr. 3. S. *Prereq:* 573 or *Geol 511*. Introduction to technologies used for remediation of contaminated soil and groundwater, including pump and treat, car-

bon absorption, soil venting, air sparging, air stripping, and in-situ bioremediation. Materials fee.

C E 578. Sustainable Water, Energy Resources, and Environment. (3-0) Cr. 3. F. *Prereq:* 4 courses in *natural, biological or engineering sciences and senior or above classification*. Integrative treatment of knowledge essential to water, renewable energy (with emphases on hydropower), and the environment; presentation of relevant science and engineering principles in both technical and conceptual terms for students of different needs and background; cross-disciplinary approach to analysis and modeling of sustainable development of water and energy and preservation of environmental integrity.

C E 579. Modeling Groundwater Flow and Pollution. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 573 or *Geol 511*. Introduction to the theory and application of finite element and finite difference methods for the numerical solution of groundwater flow and contaminant transport problems. Development and use of computer programs. Materials fee.

C E 590. Special Topics. Cr. 1 to 5 each time elected. F.S. Pre-enrollment contract required.

C E 591. Seminar in Environmental Engineering. (1-0) Cr. R. F.S. *Prereq:* Graduate classification. Contemporary environmental engineering issues. Outside speakers. Review of ongoing research in environmental engineering. Offered on a satisfactory-fail grading basis only.

C E 595. Research Methods in Construction Engineering and Management. (0-1) Cr. 1. F. *Prereq:* Credit or enrollment in 501, 502, 503, 504, or 505. Assigned readings and reports on research methods to solve construction engineering and management problems such as robotics, project controls, automation, etc. Identification of research methods and priorities, selection and development of research design, and critique of research in construction engineering and management.

C E 599. Creative Component. Cr. 1 to 3. Pre-enrollment contract required. Advanced topic for creative component report in lieu of thesis.

An undergraduate student must have an academic standing in upper one-half of his/her class in order to enroll in any 500-level civil engineering course.

Courses for Graduate Students

C E 622. Advanced Topics in Environmental Engineering. (2-0) Cr. 2. F.S. *Prereq:* Permission of *environmental engineering graduate faculty*. Advanced concepts in environmental engineering. Materials fee. Emphasis for a particular offering will be selected from the following topics:

- A. Water Pollution Control
- B. Water Treatment
- C. Solid and Hazardous Waste
- D. Water Resources

C E 649. Advanced Topics in Structural Engineering. (3-0) Cr. 3. F.S. *Prereq:* Permission of *structural engineering graduate faculty*. Advanced concepts in structural engineering topics. Materials fee. Emphasis for a particular offering will be selected from the following topics:

- A. Behavior of Metal Structures
- B. Design of Concrete Shells
- C. Cable-Supported Structures
- D. Advanced Matrix Analysis of Structures
- E. Dynamic Design of Structures
- F. Reliability Assessment of Structures.

C E 665. Advanced Concretes and Materials. (2-3) Cr. 3. Alt. S., offered 2000. *Prereq:* 566. Chemical and physical properties of portland cement and asphalt cement and their effect on concrete properties and performance. Physicochemical properties of construction materials. Mineral admixtures. Concrete durability. Material forensics. Case studies. Concrete and asphalt options offered alternate years. Materials fee.

C E 690. Advanced Topics. Cr. 1 to 3. Pre-enrollment contract required.

C E 699. Research.

Classical Studies

(Interdepartmental Undergraduate Program)

Program Committee: J. Ruebel, Chair; A. Avraamides, J. Cunnally, J. Hagge, M. Henry, J. McGlew, M. Mook, S. Petrakis, J. Thomas

The Classical Studies program is a cross-disciplinary program in the College of Liberal Arts and Sciences which offers an integrated curriculum of courses in the languages, literatures, history, and thought of ancient Greece and Rome from the time of the Homeric poems to the reign of the Emperor Constantine. The program also encourages a perspective on the contemporaries and antecedents of Greco-Roman culture, such as Egypt, the Near East and Mycenaean Greece, and on its heirs in the Middle Ages and Renaissance. Complete and current information about the Program may be found on-line at: www.public.iastate.edu/~flng_info/Classics/

Courses in Classical Studies provide background for students whose major fields of study or career interests include Anthropology, English, Foreign Languages and Literatures, History, Music, Philosophy, Women's Studies, and related fields.

The program committee will assist students interested in planning an interdisciplinary studies major. For details of the requirements for such majors within the College of Liberal Arts and Sciences, see *Liberal Arts and Sciences Cross-Disciplinary Studies*.

Completion of one year of classical Greek or Latin (or the equivalent) is a prerequisite to the minor in classical studies. A student who wishes to declare a minor must successfully complete the following requirements: (a) Greek 201 or Latin 201; (b) 273; (c) 402 or 403 or 404; (d) six additional credits from the courses listed below (primary or departmental), or as approved by the program committee. (History majors may substitute 310 for 402 or 403 or 404.)

Courses open for nonmajor graduate credit: 310, 402, 403, 404.

Primary Courses

CI St 273. Greek and Roman Mythology. (3-0) Cr. 3. F. Survey of the legends, myths, and sagas of the classical world with emphasis on the principal gods, demigods, and heroes, and their implications for ancient social, psychological, and religious attitudes; some attention given to important modern theories.

H. Honors (4-0) Cr. 4.

CI St 304. Cultural Heritage of the Ancient World. (Same as Hist 304.) See *History*.

CI St 310. Ancient Philosophy. (Same as Phil 310.) See *Philosophy*. Nonmajor graduate credit.

CI St 353. World Literature: Western Foundations through Renaissance. (Same as Engl 353.) See *English*.

CI St 372. Greek and Roman Drama. (3-0) Cr. 3. S. Origin and development of Athenian drama and its imitation at Rome; selected readings in English from Aeschylus, Sophocles, Euripides, Aristophanes, Menander, Plautus, Terence, or Seneca; ancient theater and dramatic conventions; theories of comedy or tragedy.

CI St 373. The World of Heroes in Greece and Rome. (3-0) Cr. 3. F. Investigation of the concept of the heroic in Greek and Roman epic and other relevant texts. Development of the heroic ideal; problems entailed by specific texts or kinds of texts. The heroic code and its implications for Greco-Roman concepts of the nature of humanity; problems posed by the heroic code; transformations of the code.

H. Honors (4-0) Cr. 4.

CI St 374. Women in Classical Antiquity. (Same as Hist 374, W S 374.) (3-0) Cr. 3. S. Prereq: Any one course in CI St, W S, Latin, or Greek. Chronological survey of the status of women in classical antiquity; study of constructs of the female and the feminine. Readings from ancient and modern sources. Emphasis on either Greece and Hellenistic Egypt or on Hellenistic Egypt and Rome; may be repeated once.

CI St 376. The Archaeology of Greek and Roman Religion. (Same as Rel S 376.) (3-0) Cr. 3. S. Examination of sacred space, shrine and sanctuary architecture, cult equipment, ritual and sacrifice; social implications of cult and religion. Studied chronologically through archaeological remains of material culture and texts from Bronze Age Greece through Early Imperial Rome.

CI St 394. The Archaeology of Greece: An Introduction. (2-0) Cr. 2. Alt. S., offered 2001. Introduction to the topography, history, archaeology, monuments and art of Greece from the Bronze Age through the Ottoman period; attention given to the culture of modern Greece, preparatory to study abroad in Greece (CI St 395).

CI St 395. Study Abroad: The Archaeology of Greece. Cr. 2. Alt. S., offered 2001. Prereq: 394. Supervised on-site instruction in the archaeology, monuments, and art of Greece from the Bronze Age through the Ottoman period; attention given to the culture of modern Greece; readings from ancient and modern sources. Travel to Greece will occur after the spring semester and prior to summer sessions.

CI St 402. Ancient Greece. (Same as Hist 402.) See *History*. Nonmajor graduate credit.

CI St 403. Ancient Rome. (Same as Hist 403.) See *History*. Nonmajor graduate credit.

CI St 404. Ancient Rome. (Same as Hist 404.) See *History*. Nonmajor graduate credit.

CI St 430. Development of Political Thought: Classical Thought through Early Contract Theory. (Same as Pol S 430.) See *Political Science*.

CI St 490. Independent Study. Cr. 1 to 6 each time taken. Prereq: 7 credits in classical studies at the 200 level or higher; permission of the chair of the program committee. Designed to meet the needs of students who wish to study specific topics in classical civilization in areas where courses are not offered, or to pursue such study beyond the limits of existing courses.

Courses for Graduate Students, major or minor, open to qualified undergraduates

CI St 512A. Proseminar in Ancient European History. (Same as Hist 512A.) See *History*.

CI St 594A. Seminar in Ancient European History. (Same as Hist 594A.) See *History*.

Primary Courses (Offered by Other Departments)

Art H 383. Greek and Roman Art. See *Art and Design*.

Greek 101. Elementary Classical Greek. See *Foreign Languages and Literatures*.

Greek 102. Elementary Classical Greek. See *Foreign Languages and Literatures*.

Greek 201. Intermediate Classical Greek. See *Foreign Languages and Literatures*.

Greek 306. Classical Greek Prose Composition. See *Foreign Languages and Literatures*.

Greek 342. Introduction to Classical Greek Literature. See *Foreign Languages and Literatures*.

Hist 280. Introduction to History of Science. See *History*.

Latin 101. Elementary Latin. See *Foreign Languages and Literatures*.

Latin 102. Elementary Latin. See *Foreign Languages and Literatures*.

Latin 201. Intermediate Latin. See *Foreign Languages and Literatures*.

Latin 306. Composition and Oral Interpretation. See *Foreign Languages and Literatures*.

Latin 342. Introduction to Latin Literature. See *Foreign Languages and Literatures*.

Latin 441. Advanced Readings in Latin. See *Foreign Languages and Literatures*.

Latin 442. Advanced Readings in Latin. See *Foreign Languages and Literatures*.

Sp Cm 410. Classical Rhetoric. See *Speech Communication*.

Community and Regional Planning

Riad G. Mahayni, Chair of Department

Professors: Mahayni, Shinn

Associate Professors: Borich, Huntington, Knox, Lex

Associate Professors (Emeritus): Malone

Assistant Professors: Hamin, Suen, Thompson, Wong

Assistant Professors (Adjunct): Plazak, Strauss

Undergraduate Study

For undergraduate curriculum in community and regional planning leading to the degree bachelor of science, see *College of Design, Curricula*.

Community and regional planning is concerned with the economic, social, environmental, psychological, and management aspects of change in a geographic or political area. The planner must attain a broad comprehension of city, metropolitan, urban, rural, regional, and statewide types of development, their interrelationships, and the extent of their changing needs over the short term and the middle- and long-range future.

Graduates of the Community and Regional Planning department will be capable of performing in entry level positions in public planning agencies or with planning consulting firms. Graduates are able to integrate planning knowledge and skills in practical applications to current planning issues, and to communicate in written and oral form.

Graduates of the Community and Regional Planning Department are expected to have knowledge of the structure and functions of urban settlements, the history of planning, aspects of plan and policy making, and familiarity with one area of specialized knowledge. Graduates should have skills in problem formulation, quantitative analysis, written/oral and graphic communications, collaborative approaches to these, and in synthesizing and applying knowledge to practice.

Graduates are expected to assess the impact of values in terms of equity and social justice, economic welfare and efficiency, environmental sustainability, and cultural heritage in the context of citizen involvement in decision making.

The curriculum is accredited by the Planning Accreditation Board of the American Institute of Certified Planners and the Association of Collegiate Schools of Planning, thus providing the student with an education which, when combined with experience, supports the individual's eligibility for membership in the American Institute of Certified Planners.

The department cooperates in the undergraduate minors in design studies and environmental studies.

Graduate Study

The department offers work for the master of community and regional planning degree with areas of concentration in housing and social planning, community economic development, transportation and land use, and environmental planning and design.

Degree requirements include completion of a 2-year, 48-credit program, including a thesis of 9 credits or a professional planning report of 4 credits.

The program of graduate study is accredited by the Planning Accreditation Board of the American Institute of Certified Planners and the Association of Collegiate Schools of Planning.

The planning core consists of C R P 511, 520, 522, 532, 561, and 592.

Note for C R P 520, 522: All C R P students are required to take a total of 8 credits with the required modules as C R P 520A, B, and C; and 522A, B and E.

No foreign language is required for the degree master of community and regional planning.

Satisfactory completion of the core requirements and the acceptance of a thesis (9 credits) or a professional planning report (4 credits) are required for the M.C.R.P. degree. In addition, the student is encouraged to complete three months of acceptable work experience in a planning office between the first and second year of study.

Double degree programs are offered with architecture (M.C.R.P./M.Arch.), business (M.C.R.P./M.B.A.), public administration (M.C.R.P./M.P.A.), and landscape architecture (M.C.R.P./M.L.A.). The department participates in the interdepartmental minor in housing, and in the interdepartmental major in transportation.

Courses open for nonmajor graduate credit: 380.

Courses Primarily for Undergraduate Students

C R P 253. Survey of Community and Regional Planning. (3-0) Cr. 3. F. A historical survey of planning, the nature and problems of urban areas, and the goals, procedures, and results of urban planning.

C R P 270. Forces Shaping Our Metropolitan Environment. (Same as Dsn S 270.) (3-0) Cr. 3. S.

Must be taken prior to completing 9 credits in C R P. Introduction to the social, political, physical, and economic forces as they shape metropolitan areas and their interrelationships. A comprehensive picture of metropolitan development showing important roles other urban disciplines play in the planning process and the interrelationships of the disciplines.

C R P 272. Planning Analysis and Techniques I. (2-2) Cr. 3. S. Existing and emerging techniques for preparation of community planning studies. Sources of planning information and data. Survey techniques including survey instruments, sampling methods, sample size for demographic studies. Land use surveys for comprehensive and transportation planning. Student's oral and graphic presentation of analytical results.

C R P 274. Planning Analysis and Techniques II. (2-2) Cr. 3. F. *Prereq:* 272. Use of quantitative methods for analysis of population, land use, economic and transportation make-up of a community; activities and location, intensity, and timing of land uses and public services. Student's oral and graphic presentation of analytical results.

C R P 293. Environmental Planning. (Same as Dsn S 293, Env S 293.) (3-0) Cr. 3. F. *Prereq:* *Sophomore classification.* Comprehensive overview of the field of environmental relationships and the efforts being made to organize, control, and coordinate environmental, aesthetic, and cultural characteristics of land, air, and water.

C R P 315. Housing. (Dual-listed with 515; same as Dsn S 315.) (3-0) Cr. 3. F. *Prereq:* 253 or 270. An in-depth review of the problems and issues related to housing planning and policy dealing primarily with inter-relationships and interdependencies among the socio-cultural, economic, and physical aspects of housing. Analysis of housing policy-making processes in the U.S., a comparative review of the housing policy and planning systems in selected developed and developing nations.

C R P 317. Urban Revitalization. (Dual-listed with 517; same as Dsn S 317.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 253 or 270. The nature, extent, causes, and theories of urban decline. Relationship between neighborhood change and the urban development process; public policy implications. Planning methods available to further revitalization and preservation efforts.

C R P 318. Graphic Communications in Planning. (Dual-listed with 518.) (3-0) Cr. 3. S. *Prereq:* 253 or 270. Introduction to computer graphics for majors in planning. Graphics as a means of conceptualizing ideas and communicating information. Use of Macintosh software primarily, supplemented with Ultra-Map on Apollo work stations and MS/DOS graphics on IBM/PC compatible computers.

C R P 325. Growth Management. (Dual-listed with 525; same as Dsn S 325.) (3-0) Cr. 3. F. *Prereq:* *Junior classification.* Techniques used to manage growth-related change and to implement plans. Capital investment strategies; public land acquisition and protection; development impact analysis; impact mitigation, including impact fees; phased growth systems; urban/suburban/rural relationships; and land preservation.

C R P 329. Planning in Developing Countries. (Dual-listed with 529; same as Dsn S 329.) (3-0) Cr. 3. S. *Prereq:* *Junior classification.* A variety of planning and planning-related issues including rural-urban migration, development of national policies and programs, urban decay, rural development strategies, housing problems in a developing country.

C R P 330. Practicum. Cr. 1 to 2, may be repeated up to a maximum of 2 credits. F.S.SS. *Prereq:* *Major in community and regional planning and completion of C R P 331.* Structured work experience under close supervision of a professional planner. Practical planning experience; relationships between theory and practice, professional responsibilities, and the scope of various planning roles. Practicum may be repeated. Offered on a satisfactory-fail grading basis only.

C R P 331. Professional Practice Seminar. (Dual-listed with 531.) Cr. 1. S. *Prereq:* *Major in community*

and regional planning. Preparation for working in a planning office; discussion of expectation of employer; presentations from planning professionals, and discussion of differences/similarities between public and private planning offices. This course is a prerequisite to enrollment in C R P 330, Practicum. Offered on a satisfactory-fail grading basis only.

C R P 342. Site Analysis and Development Design. (Dual-listed with 542; same as Dsn S 342.) (3-0) Cr. 3. S. *Prereq:* 253, 272. *Must be taken prior to completing 12 credits in LA.* Introduction to site analysis using landscape architecture and environmental principles, but drawing also on basic engineering concepts. Work will evolve from analysis to land development design based on that analysis.

C R P 355. Community Economic Development. (Dual-listed with 555.) (3-0) Cr. 3. S. *Prereq:* *Sophomore classification.* The nature and process of economic development in the context of community development. Recent changes and trends and their implications for local and regional development. Selected case studies and applications. Contemporary community economic development issues.

C R P 365. Technology and the City. (Dual-listed with 565; same as Dsn S 365.) (3-0) Cr. 3. F. *Prereq:* *Completion of one semester in a design, engineering, social science, or history major.* Historical development of urban areas and their change over time. Impact of technological change on development; the role that technical and design professionals (including civil engineers, architects, landscape architects, and city planners, among others) have played.

C R P 380. Regional and State Planning. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 253 or 270. Analysis of theories, policies, and functions at the metropolitan, regional, and state levels with emphasis on area-wide governance structures and strategies for guiding development. Nonmajor graduate credit.

C R P 383. Theory of the Planning Process. (3-0) Cr. 3. S. *Prereq:* 253 or 270, *junior status.* The nature of planning and its relation to social and economic planning; levels of planning, place of planning in decision making; steps in the planning process, uses and limitation of knowledge in planning, relation of facts and values.

C R P 416. Urban Design and Planning Practice. (Dual-listed with 516.) (3-1) Cr. 4. F. *Prereq:* 253 or 270. Principles of urban design and their application to residential and commercial development. Review processes and criteria for subdivision design and site planning.

C R P 427. Social Policy Planning. (Dual-listed with 527.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 253, 270, or *junior classification.* An overview of the theory and methods of social policy planning with particular attention given to the spatial relationships of policy formation, allocation of scarce resources, and the delivery of public services as an integrated part of comprehensive community planning.

C R P 432. Community Development Planning and Programming. (Dual-listed with 532.) (1-9) Cr. 4. F.S.SS. *Prereq:* 272, 274, *senior classification.* Integration of planning methods and theory in dealing with a community planning problem. Analysis of problem and formulation of strategies for implementation. Preparation of a community planning report.

C R P 435. Planning in Small Towns. (Dual-listed with 535.) (3-0) Cr. 3. F. *Prereq:* 253, 270, or *junior classification.* Contemporary planning problems in small towns and the design of viable strategies to enhance their social and economic position in today's society.

C R P 451. Introduction to Geographic Information Systems. (Dual-listed with 551.) (2-2) Cr. 3. S. Introduction to geographic information systems, including discussions of GIS hardware, software, data structures, data acquisition, analytical techniques, and implementation procedures. Laboratory emphasizes practical applications and uses of GIS.

C R P 475. Urban Planning/Urban Management. (Dual-listed with 575.) (3-0) Cr. 1 for each module, 5 weeks each. F. *Prereq:* 253 or 270 and *junior classification.* The role planning plays as a part of the man-

agement and decision-making process; policy initiation, development, and implementation; management approaches and tools.

- A. Urban Planning and Management
- B. Citizen Participation/Conflict Management
- C. Grant Writing

C R P 484. Sustainable Communities. (Dual-listed with 584; same as Dsn S 484, Env S 484.) Cr. 3. S. *Prereq: Senior status or permission of instructor.* The theory and application of sustainability to the physical and social planning of communities. We will examine environmental ethics as a basis for sustainability, the history of the idea itself and the movement toward indicators as outcome measurements both in the US and internationally. We then explore how these ideas have been or might be applied in communities here and abroad.

C R P 490. Independent Study. Cr. 1 to 3. F.S.SS. *Prereq: Written approval of instructor and department chair on required form.* Investigation of an approved topic commensurate with student's interest and ability. Offered on a satisfactory-fail grading basis only.

H. Honors

C R P 491. Environmental Law. (Dual-listed with 591; same as Dsn S 491, Env S 491.) (3-0) Cr. 3. S. *Prereq: 6 credits in natural sciences.* Legal precedents and alternative policies for environmental protection; rights to and regulations for uses of water, air and land. Federal environmental control acts and leading federal court cases.

C R P 492. Planning Law, Administration and Implementation. (Dual-listed with 592.) (3-0) Cr. 3. F. *Prereq: Junior classification and 253 or 270.* The basis in constitutional, common, and statutory law for the powers of plan effectuation. Problems of balancing public and private interests as revealed in the study of leading court cases. Administration of planning agencies and programs.

Courses Primarily for Graduate Students, open to qualified undergraduate students

C R P 511. Introduction to Community and Regional Planning. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Development of planning in the United States; history and evolution of the planning profession and constructs of current practice. Theoretical basis of planning.

C R P 515. Housing. (Dual-listed with 315; same as Dsn S 515, Hous 515.) (3-0) Cr. 3. F. *Prereq: Permission of instructor and graduate classification.* An in-depth review of the problems and issues related to housing planning and policy dealing primarily with interrelationships and interdependencies among the socio-cultural, economic, and physical aspects of housing. Analysis of housing policy-making processes in the U.S., a comparative review of the housing policy and planning systems in selected developed and developing nations.

C R P 516. Urban Design and Planning Practice. (Dual-listed with 416.) (3-1) Cr. 4. F. *Prereq: Graduate classification.* Principles of urban design and their application to residential and commercial development. Review processes and criteria for subdivision design and site planning.

C R P 517. Urban Revitalization. (Dual-listed with 317, same as Dsn S 517, Hous 517.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: Graduate classification.* The nature, extent, causes, and theories of urban decline. The relationship between neighborhood change and the urban development process and its public policy implications; the planning methods used to further revitalization and preservation efforts.

C R P 518. Graphic Communications in Planning. (Dual-listed with 318.) (3-0) Cr. 3. S. *Prereq: Graduate classification.* Introduction to computer graphics for majors in planning. Graphics as a means of conceptualizing ideas and communicating information. Use of Macintosh software primarily, supplemented with Ulti-Map on Apollo work stations and MS/DOS graphics on IBM/PC compatible computers.

C R P 520. Intermediate Planning Methods. (3-0) Cr. 1 per module. F. Modules lasting 5 weeks each.

Planning analysis of demographic trends, land use, transportation, utilities and public facilities systems, and code administration and enforcement.

- A. Population Projection and Demographic Analysis
- B. Land Use
- C. Transportation Planning
- D. Utilities and Public Facilities
- E. Codes Administration and Enforcement

C R P 522. Advanced Planning Methods. (3-0) Cr. 1 per module. S. Modules lasting 5 weeks each. *Prereq: 519A, 519C, graduate classification.* The economic make-up of a community and its analysis, economic and multi-goal evaluation analysis and financing of public projects, environmental analysis and project review.

- A. Urban and Regional Economic Analysis
- B. Economic Analysis of Public Projects
- C. Multi-Goal Evaluation of Public Projects
- D. Financing Urban Projects

C R P 525. Growth Management. (Dual-listed with 325; same as Dsn S 525.) (3-0) Cr. 3. F. *Prereq: Graduate classification.* Review of techniques used to manage growth-related change and to implement plans. Capital investment strategies; public land acquisition and protection; development impact analysis; impact mitigation, including impact fees; phased growth systems; urban/suburban/rural relationships; and land preservation.

C R P 527. Social Policy Planning. (Dual-listed with 427.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: Graduate classification.* The theory and methods of social policy planning with particular attention to the spatial relationships of policy formation, allocation of scarce resources, and the delivery of public services as an integrated part of comprehensive community planning.

C R P 529. Planning in Developing Countries. (Dual-listed with 329; same as Dsn S 529.) (3-0) Cr. 3. S. *Prereq: Graduate classification.* A variety of planning and planning-related issues including rural-urban migration, development of national policies and programs, urban decay, rural development strategies, housing problems in a developing country.

C R P 530. Practicum. Cr. 2. F.S.SS. *Prereq: Graduate classification in community and regional planning and completion of C R P 531.* Practical planning experience. Structured work in range of tasks under close supervision of a professional planner. Relationships between theory and practice, exposure to variety of roles in functioning specialties. Offered on a satisfactory-fail grading basis only.

C R P 531. Professional Practice Seminar. (Dual-listed with 331.) Cr. 1. S. *Prereq: Major in community and regional planning.* Preparation for working in a planning office; discussion of expectations of employer; presentations from planning professionals, and discussion of differences/similarities between public and private planning offices. This course is a prerequisite to enrollment in C R P 530, Practicum. Offered on a satisfactory-fail grading basis only.

C R P 532. Community Development Planning and Programming. (Dual-listed with 432.) (1-9) Cr. 4. F.S.SS. *Prereq: 519, 520, 522.* Integration of planning methods and theory in dealing with a community planning problem. Analysis of problem and formulation of strategies for implementation. Preparation of a community planning report.

C R P 535. Planning in Small Towns. (Dual-listed with 435.) (3-0) Cr. 3. F. *Prereq: Graduate classification.* Contemporary planning problems in small towns and the design of viable strategies to enhance their social and economic position in today's society.

C R P 542. Site Analysis and Development Design. (Dual-listed with 342; same as Dsn S 542.) (3-0) Cr. 3. S. *Prereq: Graduate classification. Must be taken prior to completing 12 credits in LA.* Introduction to site analysis, using landscape architecture and environmental principles; basic engineering concepts. Work will evolve from analysis to land development design based on that analysis.

C R P 551. Introduction to Geographic Information Systems. (Dual-listed with 451.) (2-2) Cr. 3. S. Introduction to geographic information systems,

including discussions of GIS hardware, software, data structures, data acquisition, analytical techniques, and implementation procedures. Laboratory emphasized practical applications and uses of GIS.

C R P 555. Community Economic Development. (Dual-listed with 355.) (3-0) Cr. 3. S. *Prereq: Graduate classification.* The nature and process of economic development in the context of community development. Recent changes and trends and their implications for local and regional development. Selected case studies and applications. Contemporary community economic development issues.

C R P 556. Economic Development in Small Communities. Cr. 1. F. Offered off campus through Continuing Education on two consecutive Fridays and Saturdays. *Prereq: Permission of instructor.* Community development perspectives, entrepreneurial approaches, leadership theories, total quality management, concepts and strategic planning skills.

C R P 561. Seminar in Planning Theory. (3-0) Cr. 3. S. *Prereq: Permission of instructor and graduate classification.* Current planning theories: comprehensive land use, advocacy, participatory, radical, and trans-active planning models. Decision making and organization models as they affect planning practice. Value conflicts and conflict resolution.

C R P 565. Technology and the City. (Dual-listed with 365; same as Dsn S 565.) (3-0) Cr. 3. F. *Prereq: Graduate classification.* Historical development of urban areas and their change over time. Impact of technological change; the role that technical and design professionals (including civil engineers, architects, landscape architects, and city planners, among others) have played.

C R P 575. Urban Planning/Urban Management. (Dual-listed with 475.) (3-0) Cr. 1 per module, 5 weeks each. F. *Prereq: Graduate classification.* The role planning plays as a part of the management and decision-making process; policy initiation, development, and implementation; management approaches and tools.

- A. Urban Planning, Urban Management
- B. Citizen Participation/Conflict Management
- C. Grant Writing

C R P 580. Seminar in Regional Planning and Development. (3-0) Cr. 3. Alt. F., offered 2001. *Prereq: Graduate classification.* Regional development issues and policies in advanced and developing countries. Theories and methods, distribution of economic activities and settlement patterns. Role of infrastructure in development.

C R P 584. Sustainable Communities. (Dual-listed with 484; same as Dsn S 584.) Cr. 3. S. *Prereq: Graduate classification.* The theory and application of sustainability to the physical and social planning of communities. We will examine environmental ethics as a basis for sustainability, the history of the idea itself, and the movement toward indicators as outcome measurements both in the US and internationally. We then explore how these ideas have been or might be applied in communities here and abroad.

C R P 590. Special Topics. Cr. 1 to 3. F.S.SS. *Prereq: Graduate classification and written approval of instructor and department chair on required form.*

- A. Planning Administration
- B. Local Economic Development
- C. Urban Design
- D. Housing
- E. Neighborhood Renewal
- F. Social Planning
- G. Regional Economic Development
- H. Environmental Planning
- I. Transportation Planning
- J. Policy Analysis
- K. State Planning
- L. Planning in Developing Countries

C R P 591. Environmental Law. (Dual-listed with 491; same as Dsn S 591, Env S 491.) (3-0) Cr. 3. S. *Prereq: Graduate classification.* Legal precedents and alternative policies for environmental protection; rights to and regulations for uses of water, air, and land. Federal environmental control acts and leading federal court cases.

C R P 592. Planning Law, Administration and Implementation. (Dual-listed with 492.) (3-0) Cr. 3. F. Prereq: Graduate classification. The basis in constitutional, common, and statutory law for the powers of plan effectuation. Problems of balancing public and private interests as revealed in the study of leading court cases. Administration of planning agencies and programs.

Courses for Graduate Students

C R P 598. Professional Planning Report. (Arr.) Cr. Var. F.S.SS. Independent student research on planning topic. The course will serve as a capstone experience for the student, demonstrating ability to integrate planning knowledge and skills in the practical application of the student's abilities on a current planning issue. The completed report must be submitted to and approved by the POS committee as evidence of the mastery of the principles of community and regional planning.

C R P 699. Research. Cr. Var. F.S.SS.

Computer Engineering

(Administered by the Department of Electrical and Computer Engineering)

Subrahmanyam Venkata, Chair of Department

Distinguished Professors: Lord

University Professors: Jones, Wright

Professors: Anderson, Basart, Dalal, Geiger, Horton, Kothari, Jiles, Lamont, Melsa, Sheblé, Snow, Somani, S. Udpa, Venkata, Vittal, Weber

Professors (Adjunct): Hillesland, Shurtleff

Distinguished Professors (Emeritus): Brown, Nilsson, Pohm

Professors (Emeritus): Brearley, Brockman, Comstock, Fanslow, Hale, Hsieh, Koerber, Kopplin, Potter, Read, Smay, Stewart, Swift, Townsend, Triska

Associate Professors: Ajarapu, Bartlett, Black, Carlson, Chen, Davidson, Davis, Han, Hassoun, Jacobson, Khammash, Kleitsch, Kruempel, McCalley, Mohapatra, Russell, Sapatnekar, Stephenson, Tuttle, L. Udpa

Associate Professors (Emeritus): Bond, Coady, McMechan, Mericle, Pavlat, Scott

Assistant Professors: Barton, Cruz-Neira, Dickerson, Govindarasu, Lee, Patterson, Salapaka

Instructors (Adjunct): Freeman

Undergraduate Study

For undergraduate curriculum in computer engineering leading to the degree bachelor of science, see *College of Engineering, Curricula*. This curriculum is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

The Electrical and Computer Engineering (ECPE) Department at Iowa State University provides undergraduate students with the opportunity to learn electrical and computer engineering fundamentals, to study applications of the most recent advances in state-of-1999-2001

the-art technologies, and to prepare for the practice of engineering. The student-faculty interaction necessary to realize this opportunity occurs within an environment that is motivated by the principle that excellence in undergraduate education is enhanced by an integrated commitment to successful, long-term research and outreach programs.

The computer engineering curriculum offers two specialization areas at the undergraduate level: computer networking and security, and computer architecture and digital systems. Students may also take elective courses in control systems, electromagnetics, microelectronics, VLSI, power systems, and communications and signal processing.

The mission of the ECPE Programs at Iowa State University is to enable the graduated student to make significant and substantive contributions to solving engineering problems throughout the student's professional career. The following objectives are identified as critical to the accomplishment of this mission.

1. Impart and enhance knowledge in the domain of electrical and computer engineering: The graduated student should understand (a) engineering and basic science fundamental including mathematics, probability, statistics, physical sciences, and information technology, (b) the design and manufacturing processes, (c) the fundamentals of business, including entrepreneurship, engineering economy, and cost/revenue streams.

2. Expand and hone engineering abilities: The graduated student should be able to (a) identify and solve engineering problems, (b) analyze and design electrical, computer, and multidisciplinary systems, (c) design and conduct experiments and analyze resulting data, (d) use modern engineering hardware and software tools such as computers and instrumentation.

3. Instill and nurture social awareness, abilities, and understanding: The graduated student should (a) desire to engage in lifelong learning, and should expect and embrace change, (b) be able to function effectively as a member of a multidisciplinary team, to communicate effectively, and to think critically and creatively, both independently and with others, (c) apply standards of professional conduct in view of the value of science and technology in a global/societal context.

As a complement to the instructional activity, the ECPE Department provides opportunities for each student to have experience with broadening activities. Through the Cooperative Education and Internship Program, students have the opportunity to gain practical industry experience. See *College of Engineering, Cooperative Programs*. Through the Undergraduate Research Program, students have the opportunity to participate in advanced research activities; and through international exchange programs, students learn about engineering practices in other parts of the world.

Students are required to prepare and to maintain a portfolio of their technical and non-technical skills. This portfolio is evaluated for student preparation during the student's curriculum planning process. Results of the evaluation are used to advise students of core strengths and weaknesses. Prerequisite material exams are given at key points in the curriculum. These exams are to assist student evaluation of progress made during the academic experience as the material covered in several courses are the foundation of more advanced courses. These outcome assessments are also used to assess and to improve the quality of the curriculum.

Credit in Cpr E 320 may not be counted toward a degree in computer engineering.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with major in computer engineering and minor work to students with other majors. Minor work for computer engineering majors is usually selected from a wide range of courses outside computer engineering. The department also participates in the technology and social change inter-departmental minor.

The degree master of science with thesis is recommended for students who intend to continue toward the doctor of philosophy degree or to undertake a career in research and development. The nonthesis master of science degree requires a creative component.

The normal prerequisite to major work in computer engineering is the completion of undergraduate work substantially equivalent to that required of computer engineering students at this university. It is possible for a student to qualify for graduate study in computer engineering even though the student's undergraduate or prior graduate training has been in a discipline other than computer engineering. Supporting work, if required, will depend on the student's background and area of research interest. Prospective students from a discipline other than computer engineering are required to submit, with the application for admission, a statement of the proposed area of graduate study.

The department requires submission of GRE aptitude test scores by applicants from other countries. All students whose first language is not English and who have no U.S. degree must submit TOEFL examination scores. Ph.D. students must pass a department qualifying examination.

Courses open for nonmajor graduate credit: all 300 and 400 level courses except 310, 370, 396, 397, 398, 466, 490, 491, 492, and 498.

Courses Primarily for Undergraduate Students

Cpr E 210. Introduction to Digital Design. (3-2) Cr. 4. F.S. Prereq: Sophomore classification. Number systems and codes. Combinational and sequential logic. Logic elements. Digital representation of data. Design of digital systems and subsystems. Introduction to computer-aided schematic capture systems, simulation tools, hardware description lan

gates, and programmable logic devices. Design of a simple digital computer.

Cpr E 211. Introduction to Microcontrollers. (3-2) Cr. 4. F.S. *Prereq:* 210, Com S 207 or 227. Logic families. Documentation standards. Implementation and testing of combinatorial and sequential systems and subsystems. Introduction to microcontrollers. Microprocessor registers, memory, and programmable input/output devices. Interrupts. Single chip controllers. Design and testing of software for microcontrollers. Hardware/software design tradeoffs and issues. Individual design projects.

Cpr E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of department chair; sophomore classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Cpr E 301. Microprocessor-Based Design. (3-3) Cr. 4. F.S. *Prereq:* 211. Use of microcomputers as system components. Digital and non-digital interfacing. Examination of the role of standard system buses and standard interfaces. Use of advanced system development tools, in both assembly-language and high-level-language environments. Laboratory-oriented design projects. Nonmajor graduate credit.

Cpr E 305. Computer Systems Organization and Architecture. (3-0) Cr. 3. F.S. *Prereq:* 211 or Com S 321. Introduction to computer organization, evaluating performance of computer systems, instruction set design, computer arithmetic, processor design; datapath and control, pipelining, memory organization, interfacing processors and peripherals, introduction to multiprocessor architectures. Nonmajor graduate credit.

Cpr E 308. Software Systems Integration. (3-3) Cr. 4. F.S. *Prereq:* 301, 305, 310, Com S 311, Engl 314. Introduction to software systems and solutions. Integration of software and hardware for a computer system. Interrupts, reentrant code, critical regions, real-time problems, I/O, device drivers, tasking, memory management, debugging techniques, software testing, documentation. Laboratory oriented design projects focusing on the design and implementation of a large software system. Nonmajor graduate credit.

Cpr E 310. Theoretical Foundations of Computer Engineering. (3-0) Cr. 3. F.S. *Prereq:* Credit or enrollment in Cpr E 211, Com S 228. Foundational material for the study of computer codes, computer arithmetic, digital circuit design and computer system performance. Topics include discrete mathematics, probability and statistics, and linear algebra. Applications to problems in computer engineering.

Cpr E 320. Software Engineering for Electrical Engineers. (3-0) Cr. 3. F.S. *Prereq:* 211, E E 321, Math 273. (Credit in 320 cannot be counted toward a Cpr E degree.) Integrated engineering of hardware/software systems. Software design, testing, documentation, maintenance, debugging. Version control. Software portability and reusability. Hardware/software tradeoffs and partitioning. Software design for control applications. Nonmajor graduate credit.

Cpr E 370. Toying with Technology. (Same as Mat E 370.) (2-2) Cr. 3. F.S. *Prereq:* Junior standing in non-engineering major. A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on laboratory experiences based upon simple systems constructed out of LEGOSs and controlled by small microcomputers. Future K-12 teachers will leave the course with complete lesson plans for use in their upcoming careers.

Cpr E 396. Summer Internship for International Students. Cr. R. SS. *Prereq:* Permission of department. Summer professional work period for international students.

Cpr E 397. Engineering Internship. Cr. R. F.S. *Prereq:* Permission of department. One semester maximum per academic year professional work period.

Cpr E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of department chair; junior classification. Required of all cooperative education stu-

dents. Students must register for this course prior to commencing each work period.

Cpr E 425. High Performance Computing for Scientific and Engineering Applications. (Same as Com S 425.) See *Computer Science*.

Cpr E 454. Implementation of Operating Systems and Distributed Computing Environment. (Dual-listed with 554; same as Com S 454.) See *Computer Science*.

Cpr E 465. Digital VLSI Layout and Design. (Same as E E 465.) (3-3) Cr. 4. F. *Prereq:* 211, E E 333. Introduction to CMOS VLSI layout and circuit design methodologies for custom VLSI to high level synthesis of digital VLSI systems. This includes layout design rules, logic implementation techniques, timing analysis, power consumption and scaling. Different CMOS design styles including static, dynamic domino and pseudo-NMOS. This lab includes custom VLSI, standard cell and high level synthesis design and implementation experiments. A VLSI chip design hardware project is required. Nonmajor graduate credit.

Cpr E 466. Multidisciplinary Engineering Design. (Same as A E 466, E E 466, E Sci 466, I E 466, Mat E 466.) (1-4) Cr. 3. F. S. *Prereq:* Student must be within two semesters of graduation and receive permission of instructor. Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of design journals, written reports, oral presentations and computer models and engineering drawings.

Cpr E 484. Advanced Digital Systems Design. (2-3) Cr. 3. S. *Prereq:* 305. Introduces the architecture of digital systems, emphasizing structural principles common to a wide range of technologies. Multilevel implementation strategies; definition of new primitives (e.g. gates, instructions, procedures, processes) and their mechanization using lower-level elements. Instruction set design issues including architectural support for contemporary software structures. Laboratory based with an emphasis on the use of hardware description languages and programmable logic devices. Nonmajor graduate credit.

Cpr E 489. Computer Networking and Data Communications. (3-0) Cr. 3. F.S. *Prereq:* 305 or E E 324. Survey of modern computer networking and data communications. Contemporary concepts, facilities, practices, implementations, and issues. TCP/IP, OSI protocols, client server programming. Nonmajor graduate credit.

Cpr E 490. Independent Study. Cr. arr. *Prereq:* Senior classification in computer engineering. Investigation of an approved topic. H. Honors

Cpr E 491. Senior Design Project I. (Same as E E 491.) (1-3) Cr. 2. F.S. *Prereq:* E E 251 or Cpr E 308, completion of 29 credits in the E E or Cpr E core professional program, Engl 314. First semester of a team design project experience. Emphasis on defining and planning to achieve project objectives that meet a client's need. Technical writing of project plan and design review; project poster.

Cpr E 492. Senior Design Project II. (Same as E E 492.) (1-3) Cr. 2. F.S. *Prereq:* Cpr E 491 or E E 491. Second semester of a team design project experience. Emphasis on achieving project objectives as defined in Cpr E 491 or E E 491. Technical writing of final project report; oral presentation of project achievements.

Cpr E 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of department chair; senior classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, open to qualified undergraduate students

Cpr E 501. Analog VLSI Circuit Design. (Same as E E 501.) (3-3) Cr. 4. F. *Prereq:* E E 465 or E E 434. Design techniques for analog and mixed-signal VLSI circuits. Amplifiers; operational amplifiers, transconductance amplifiers, finite gain amplifiers and current amplifiers. Linear building blocks; differential amplifiers, current mirrors, references, cascoding and buffering. Performance characterization of linear integrated circuits; offset, noise, sensitivity and stability. Layout considerations, simulation, yield and modeling for high-performance linear integrated circuits.

Cpr E 505. CMOS and BiCMOS Data Conversion Circuits. (Same as E E 505.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* E E 465 and E E 434, or 501 or instructor consent. Theory, design and applications of CMOS and BiCMOS data conversion circuits (A/D and D/A converters) including: quantization effects, conversion algorithms, sample and holds, element matching, comparators, voltage references and detailed implementation issues.

Cpr E 519. Computer Graphics and Geometric Modeling. (Same as M E 519) (3-0) Cr. 3. F. *Prereq:* M E 421, programming experience in C. Fundamentals of computer graphics technology. Data structures. Parametric curve and surface modeling. Solid model representations. Applications in engineering design, analysis, and manufacturing.

Cpr E 525. Numerical Analysis of High-Performance Computing. (Same as Com S 525, Math 525.) (3-0) Cr. 3. S. *Prereq:* 308, or one of Math 273, 471, 481; experience in scientific programming; knowledge of FORTRAN or C. Development, analysis, and testing of efficient numerical methods for use on state-of-the-art high performance computers. Applications of the methods to the student's area of research.

Cpr E 526. Practical Introduction to Parallel Programming. (Same as Com S 526.) See *Computer Science*.

Cpr E 531. Information System Security. (3-0) Cr. 3. *Prereq:* 308 or 584, and 489 or 580. Computer and network security: basic cryptography, security policies, multilevel security models, attack and protection mechanisms, legal and ethical issues.

Cpr E 532. Information Warfare. (3-0) Cr. 3. S. *Prereq:* 531. Computer system and network security: implementation, configuration, testing of security software and hardware, networking monitoring. Computer attacks and countermeasures. Emphasis on laboratory experiments.

Cpr E 533. Cryptography. (Same as Math 533.) See *Mathematics*.

Cpr E 541. High-Performance Communication Networks. (3-0) Cr. 3. F. *Prereq:* 580 or Com S 586. Selected topics from recent advances in local area networks, metropolitan area networks, asynchronous transfer mode, high-speed optical networks, high-speed switch architectures, multicasting for teleconferencing applications, wireless and mobile computing.

Cpr E 545. Fault-Tolerant Systems. (3-0) Cr. 3. *Prereq:* 305. Faults and their manifestations, errors, failures, reliability and availability techniques. Designing highly reliable systems, redundancy management, fault detection, location and reconfiguration. Testing, design for testability, self-checking and fail-safe circuits, coding techniques. System-level fault diagnosis, fault-tolerant communication, fault tolerant multiprocessor systems. Reliable software design, low-overhead high-availability techniques. Evaluation methods.

Cpr E 554. Implementation of Operating Systems and Distributed Computing Environment. (Dual-listed with 454; same as Com S 554.) See *Computer Science*.

Cpr E 560. Algorithmic Methodologies in Computer-Aided Design. (3-0) Cr. 3. *Prereq:* Experience with any high-level computer language. Theoretical methods and practical case studies in the area of computer-aided design for VLSI on the following topics: essentials of data structures, NP-completeness, graph algorithms, dynamic programming, linear and nonlinear programming, branch-and-bound methods, greedy algorithms, backtracking techniques, divide-and-conquer algorithms, Markov chains.

Cpr E 564. Synthesis and Optimization of Digital Circuits. (3-0) Cr. 3. *S. Prereq:* 305. Algorithms and techniques to generate application-specific VLSI circuits from high-level behavioral modeling in hardware description languages. Hardware models, architectural-level synthesis and optimization, scheduling algorithms, resource sharing and binding, logic-level synthesis and optimization, sequential logic optimization, system-level synthesis, hardware-software co-design.

Cpr E 566. Physical Design of VLSI Systems. (3-0) Cr. 3. Physical design of VLSI systems. Partitioning algorithms. Placement and floorplanning algorithms. Routing-global and detailed. Layout compaction. Physical design of FPGA's and MCM's. Interconnect optimization. Performance-driven layout synthesis.

Cpr E 567. CAD Algorithms for VLSI Design. (3-0) Cr. 3. Simulation algorithms for VLSI circuits. Formulation of circuit equations. Transistor-level modeling. Solution of circuit equations. Transient analysis and sensitivity analysis. Latency and timing analysis. Logic/timing simulations. Mixed-mode simulation. Asymptotic waveform evaluation (AWE). Parallel algorithms.

Cpr E 580. Advanced Computer Networking Data Communications. (3-0) Cr. 3. *S. Prereq:* 489. Design, implementation, and analysis of computer networks and data communications systems. Detailed examination of modern communication standards, protocol systems and their implementation. Transmission technology, packet switching, routing, flow control, and protocols.

Cpr E 582. Computer Systems Performance. (3-0) Cr. 3. *Prereq:* 305, 310. Workload characterization and fundamental laws, introduction to queuing theory, analysis and solutions of queuing models, mean value analysis and related techniques, stochastic processes, Markov chains and Petri nets. Analysis of specific subsystems: processor, memory, and I/O disks. Performance analysis of multiprocessor architectures, simulation techniques and use of software tools for performance analysis.

Cpr E 583. Adaptive Computing Systems. (3-0) Cr. 3. *Prereq:* Background in computer architecture, design, and organization. Introduction to adaptive/reconfigurable computing, FPGA technology and architectures, spatial computing architectures, systolic and bit serial architectures, adaptive network architectures, bus-based and static dynamic rearrangeable interconnection structure architectures, reconfigurable computing architectures for processors, pipeline, and caches.

Cpr E 585. Advanced Computer Architecture. (3-0) Cr. 3. *F. Prereq:* 305. Quantitative principles of computer design, instruction set design, processor architecture: pipelining and superscalar design, instruction level parallelism, memory organization: cache and virtual memory systems, multiprocessor architecture, cache coherency, interconnection networks and message routing, I/O devices and peripherals.

Cpr E 588. Embedded Computer Systems. (3-0) Cr. 3. *S. Prereq:* 308. Design, implementation, and testing of embedded computer systems. Concurrency, real-time control, hardware/software interfaces, and error handling.

Cpr E 590. Special Topics. Cr. 1 to 6 each time elected. Formulation and solution of theoretical or practical problems in computer engineering.

Cpr E 592. Seminar in Computer Engineering. Cr. 1 to 4 each time elected. *Prereq:* Permission of instructor. Projects or seminar in Computer Engineering.

Cpr E 594. Selected Topics in Computer Engineering. (3-0) Cr. 3.

Cpr E 599. Creative Component. Cr. var.

Courses for Graduate Students

Cpr E 699. Research. Cr. var.

Computer Science

Leslie L. Miller, Interim Chair of Department

Professors: Fernandez-Baca, Lutz, Miller, Oldehoeft, Slutzki

Professors (Emeritus): Brearley, Stewart, Thomas

Associate Professors: Baker, Chaudhuri, Gadia, Honavar, Leavens, Ostendorf, Prabhu, Strawn, Tyagi, Wong

Associate Professors (Adjunct): Gustafson, Heller

Assistant Professors: Chou, Lavalley, Sekar

Assistant Professors (Adjunct): Boysen

Instructors (Adjunct): Rose

Undergraduate Study

The curriculum in Liberal Arts and Sciences leading to a bachelor of science degree with a major in computer science is designed to prepare students for positions as computer scientists with business, industry, or government, or for graduate study in computer science. This program has been accredited by the Computing Sciences Accreditation Board, Inc.

To complete an undergraduate degree in Computer Science, a student must satisfy the requirements of the College of Liberal Arts and Sciences (see *Liberal Arts and Sciences, Curriculum*) and include the following courses within the group requirements: Phil 442; Sp Cm 212: 14 credits of math and statistics including Math 165, 166 and at least one math course from Math 265, 266, 304, 307, 314, or 317, and at least one stat course from Stat 105, 231, 305, 333, or 341; a minimum of 12 credits of natural science including Phys 221, 222, and at least one additional natural science course from the following list: A Ecl 231, 312, 320, 320L, 321-324, Anthr 202, 307, BBMB 221, Biol 201, 201L, 202, 202L, 312, Bot 102, 202, 304, 307, Chem 163-232, Ent 370, Env S 223, 324, FS HN 167, Gen 260, Geol 100-106, 201, 306, 311, 412, Mat E 207, Mteor 206, 301, 301L, Psych 310, Zool 155, 156, 258, 310; English proficiency requirement: Engl 104, 105 and one of Engl 302, 305, 309 or 314. The minimum grade accepted in each of the three required courses is a C-.

Students wishing to pursue the B.S. degree in computer science must first successfully complete the premajor program consisting of the following courses and minimum grade requirements:

Course	Minimum Grade
104	C-
227	C-
228	C-
Math 165	C-

Students majoring in computer science must successfully complete this premajor program prior to taking any other courses in the Department. Thus, for computer science

majors, this premajor serves as a necessary prerequisite to all the other courses offered by the Department.

A minimum of 44 credits is required for the B.S. degree in computer science. The required courses are: Com S 101, 104, 203, Cpr E 210, Com S 227, 228, 309, 311, 321, 330, 331, 342, 352, 361. In addition, two advanced-level courses must be selected from the following groups:

Group W: 411, 440, 454, 476

Group B: 401, 425, 430, 461, 472, 474

Group N: Math 471, Math 481, Cpr E 484, Cpr E 489, M E 519

Courses in Group W require written reports and those in Group B require both oral and written reports. Students must take one course from Group B and one course from any group.

Students must earn a C- or better in each course in the department which is a prerequisite to a course listed in the student's degree program.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with a major in Computer Science. The doctor of philosophy may also be earned with computer science as a co-major with some other discipline. Additionally, the department offers minor work to students majoring in other departments.

Facilities exist for research in such areas as algorithms, artificial intelligence, computational complexity, computer architecture, computer networks, database systems, formal languages and automata, machine learning and neural networks, parallel and distributed computing, robotics, software engineering, and VLSI. There are also numerous opportunities for interdisciplinary research.

Typically, students beginning graduate work in Computer Science have completed a bachelor's degree or equivalent in Computer Science. However, many students with undergraduate majors in other areas, such as mathematical, physical, or biological science or engineering, become successful graduate students in Computer Science.

For the degree master of science, a minimum of 31 semester credits are required. Both thesis and non-thesis options are available. If no thesis is presented, the preparation of a paper demonstrating ability to organize and express significant ideas in computer science is required.

The purpose of the doctoral program is to train students to do original research in Computer Science. Each student is also required to attain knowledge and proficiency commensurate with a leadership role in the field. The Ph.D. requirements, governed by the student's program of study committee within established guidelines of the department and the graduate college, include coursework, demonstrated proficiency in three areas of Computer Science, a research skills requirement, a preliminary examination, and a doctoral dissertation and final oral examination

The department recommends that all graduate students majoring in Computer Science teach

as part of their training for an advanced degree.

Courses open for nonmajor graduate credit: 309, 311, 321, 330, 331, 342, 352, 361, 401, 411, 425, 430, 440, 454, 461, 471, 472, 474, 476, 481, 484.

Courses Primarily for Undergraduate Students

Com S 101. Orientation. (1-0) Cr. R. F. S. Introduction to the procedures and policies of Iowa State University and the Department of Computer Science s, test-outs, honoraries, etc. Issues relevant to student adjustment to college life will also be discussed. Offered on a satisfactory-fail grading basis only.

Com S 103. Computer Applications. (3-2) Cr. 4. F.S. Introduction to microcomputer literacy and applications. Applications: Windows, Internet browser/HTML, word processing, spreadsheets, database management and presentation. Literacy: the history of computing, structure of computers, telecommunications, computer ethics, computer crime, and history of programming languages. No prior computer experience necessary.

Com S 104. Introduction to Computers. (3-2) Cr. 4. F. Use of personal computer and workstation operating systems and software. Overview of machine architecture and telecommunications. Project-oriented approach to word processing, spreadsheet, presentation, database management, e-mail, Internet usage, HTML and other software. Beginning programming in Visual BASIC, and animation scripting. Topics from computer history, programming languages, algorithm development, and societal impact. No prior computer experience necessary. This course is for computer science majors.

Com S 107. Applied Computer Programming. (3-0) Cr. 3. F.S. *Prereq:* 103, *Math 104 or 140 or 150.* Introduction to computer programming for nonmajors using a language such as the Visual BASIC language. Basics of good programming and algorithm development.

Com S 201. Computer Programming in COBOL. (3-0) Cr. 3. F.S. *Prereq:* 107 or 207 or 227. Computer programming using the COBOL language. Emphasis on the design, writing, debugging, and testing of business applications programs in a transaction-oriented environment.

Com S 203. Careers in Computer Science. (1-0) Cr. R. Half semester. F.S. Computer science as a profession. Introduction to career fields open to computer science majors. Relationship of coursework to careers. Presentations by computer science professionals. Offered on a satisfactory-fail grading basis only.

Com S 207. Programming I. (3-1) Cr. 3. F.S. *Prereq:* *Math 150 or placement into Math 140/141/142 or higher.* An introduction to computer programming using an object-oriented programming language. Emphasis on basics of good programming techniques and style through extensive practice in writing, running, and debugging programs. This course is designed for nonmajors; those contemplating a major in computer science should take 227. Credit may not be applied toward graduation for both 207 and 227.

Com S 208. Programming II. (3-1) Cr. 3. F.S. *Prereq:* 207, *credit or enrollment in Math 151, 160, or 165.* An introduction to data structures and algorithm analysis using an object-oriented language. Recursion. List and file processing. Dynamic data structures. Emphasis on writing and running programs. This course is designed for nonmajors. Credit may not be applied toward the major.

Com S 227. Introduction to Computer Programming. (3-1) Cr. 3. F.S. *Prereq:* *Math 141/142 or placement into Math 165 or higher, credit or enrollment in Math 165.* An introduction to computer programming. Symbolic and numerical computation. Recursion and iteration. Modularity and data abstraction. Object-oriented techniques. Imperative programming. Emphasis on principles of programming and program design through extensive practice

in writing, running, and reasoning about programs. This course is designed for majors. Credit may not be applied toward graduation for both 207 and 227.

Com S 228. Introduction to Data Structures. (3-1) Cr. 3. F.S. *Prereq:* 227, *Math 165, credit or enrollment in 104 and Math 166.* An object-oriented approach to data structures and algorithms. Object-oriented programming. Program correctness. Stacks, queues, trees, searching, sorting, analysis of algorithms, graphs, and file processing. Emphasis on writing and running programs. This course is designed for majors.

Com S 290. Independent Study. Cr. arr. F.S. *Prereq:* *Permission of instructor.* Offered on a satisfactory-fail grading basis only.
H. Honors

Com S 309. Software Development Practices. (3-1) Cr. 3. F.S. *Prereq:* 228. A practical introduction to methods for managing software development. Process models, requirements analysis, structured and object-oriented design, coding, testing, maintenance, cost and schedule estimation, metrics. Nonmajor graduate credit.

Com S 311. Design and Analysis of Algorithms. (3-1) Cr. 3. F.S. *Prereq:* 228, 330 or *Cpr E 310, Math 166.* Basic techniques for design and analysis of efficient algorithms that act on data structures. Set manipulation, sorting, graph processing, and memory management algorithms. Programming projects. Nonmajor graduate credit.

Com S 321. Introduction to Computer Architecture and Machine-Level Programming. (3-1) Cr. 3. F.S. *Prereq:* 228 and *Cpr E 210.* Machine-level programming including assembly language. Input/output and interrupts. Introduction to computer architecture and organization with emphasis on instruction sets, memory-hierarchy design, and performance. Nonmajor graduate credit.

Com S 330. Discrete Computational Structures. (3-1) Cr. 3. F.S. *Prereq:* 227 and *Math 165.* Concepts in discrete mathematics as applied to computer science. Logic, set theory, relations, graphs, combinatorics and their computational aspects. Nonmajor graduate credit.

Com S 331. Theory of Computing. (Same as Ling 331.) (3-1) Cr. 3. F.S. *Prereq:* 330 or *Cpr E 310, Math 166.* Models of computation: finite state automata, pushdown automata and Turing machines. Study of grammars and their relation to automata. Limits of digital computation, unsolvability and Church-Turing thesis. Chomsky hierarchy and relations between classes of languages. Nonmajor graduate credit.

Com S 342. Principles of Programming Languages. (3-1) Cr. 3. F.S. *Prereq:* 321, 330 or *Cpr E 310, and either 309 or 361.* Organization of programming languages emphasizing language design concepts and semantics. Study of language features and major programming paradigms, including functional programming. Programming projects. Nonmajor graduate credit.

Com S 352. Introduction to Operating Systems. (3-1) Cr. 3. F.S. *Prereq:* 321, 361. Survey of operating system issues. Introduction to hardware and software components including: processors, peripherals, interrupts, process and memory management, deadlocks, file systems, protection, virtual machines and system organization, and introduction to distributed operating systems. Programming projects. Nonmajor graduate credit.

Com S 361. File Organization and Processing. (3-1) Cr. 3. F.S. *Prereq:* 228. Concepts and techniques of structuring and processing data on external storage devices. Hardware and its parameters. Basic file organization including: sequential, indexed, indexed sequential, and hash files. Hybrid file organization. Nonmajor graduate credit.

Com S 398. Cooperative Education. Cr. R. Required of all cooperative students. *Prereq:* *Permission of department chair.* Students must register for this course prior to commencing each work period.

Com S 401. Computer Based Information Systems. (2-2) Cr. 3. F. *Prereq:* 361, *Engl 105,*

Sp Cm 212 and an additional 9 credits in Com S at the 200 level or above. Systems concepts and implementations for supporting production-oriented information systems; data and terminal access methods; operating systems implementations; data base management systems implementations; data dictionary considerations; data communication considerations; lab experiments and implementations. Oral and written reports. Nonmajor graduate credit.

Com S 411. Specification and Design in Software Engineering. (3-1) Cr. 3. Alt. F., offered 1999. *Prereq:* 311 or *Cpr E 305, Engl 105, Sp Cm 212.* Principles and techniques for methodical construction of quality software. Software requirements specification; programming paradigms; module specification techniques; testing and validation procedures; proof of program correctness. Emphasis on team projects. Written reports. Nonmajor graduate credit.

Com S 425. High Performance Computing for Scientific and Engineering Applications. (Same as Cpr E 425.) (3-1) Cr. 3. Alt. S., offered 2000. *Prereq:* 311, 330, *Engl 105, Sp Cm 212.* Introduction to high performance computing using different computing platforms including parallel computers and workstation clusters. Discussion of performance, visualization, and software development issues. Sample applications from science and engineering. Practical issues in high performance computing will be emphasized via a number of programming projects and case studies. Oral and written reports. Nonmajor graduate credit.

Com S 430. Advanced Programming Tools. (3-1) Cr. 3. Alt. F., offered 2000. *Prereq:* 311, 361, *Engl 105, Sp Cm 212.* Topics in advanced programming techniques and tools widely used by industry (e.g., event-driven programming and graphical user interfaces, standard libraries, advanced topics in object-oriented programming, client/server architectures and techniques for distributed applications). Emphasis on programming projects in a modern integrated development environment. Oral and written reports. Nonmajor graduate credit.

Com S 440. Principles of Compiling. (Dual-listed with 540.) (3-1) Cr. 3. S. *Prereq:* 331, 342, *Engl 105, Sp Cm 212.* Implementation of programming languages, emphasizing project work to construct a compiler/interpreter for Java subset or similar language. Project uses compiler-generator tools and object-oriented software design and development. Topics covered: lexical, syntax and semantic analyses; syntax-directed translation; implementation of interpreters; code generation and optimization. Different projects will be assigned for 540 and 440. Written reports. Nonmajor graduate credit.

Com S 454. Distributed and Network Operating Systems. (Dual-listed with 554; same as Cpr E 454.) (3-1) Cr. 3. Alt. S., offered 2001. *Prereq:* 311, 352, *Engl 105, Sp Cm 212.* Laboratory course dealing with practical issues of design and implementation of distributed and network operating systems and distributed computing environments (DCE). These include client server paradigm, inter-processes communications, layered communication protocol, synchronization and concurrency control, and distributed file systems. Graduate credit requires additional in-depth study of advanced operating systems. Written reports. Nonmajor graduate credit.

Com S 461. Introduction to Database Systems. (3-1) Cr. 3. F. *Prereq:* 311, 361, *Engl 105, Sp Cm 212.* Introduction to database concepts, data models (relational, hierarchical, and network models), data manipulation languages, data description languages, system implementation issues, security and data integrity. Oral and written reports. Nonmajor graduate credit.

Com S 471. Computational Linear Algebra and Fixed Point Iteration. (Same as Math 471.) See *Mathematics.* Nonmajor graduate credit.

Com S 472. Principles of Artificial Intelligence. (Dual-listed with 572.) (3-1) Cr. 3. F. *Prereq:* *Engl 105, Sp Cm 212, Com S 330 or Cpr E 310, Com S 342, or comparable programming experience.* Foundations, scope, and problems of artificial intelligence (AI) and cognitive science. State-space search techniques for

problem solving. Knowledge representation and automated inference. Machine learning. Neural and evolutionary approaches to AI. Artificial life. Selected applications in planning, machine perception, analysis, design, and intelligent agent architectures. AI programming using common LISP. Graduate credit requires a research project and a written report. Oral and written reports. Nonmajor graduate credit.

Com S 474. Elements of Neural Computation. (3-1) Cr. 3. S. *Prereq: Engl 105, Sp Cm 212, Math 165, 330 or Cpr E 310, and programming experience.* Introduction to theory and applications of neural and evolutionary computation. Mathematical and computational models of neurons and networks of neurons. Neural associative memories, pattern classifiers, function approximators, and learning algorithms. Stochastic search and genetic algorithms. Applications in artificial intelligence, cognitive and neural modeling, computer science and robotics. Hands-on experience with neural and evolutionary computation emphasized through the use of simulation tools and laboratory projects. Oral and written reports. Nonmajor graduate credit.

Com S 476. Motion Strategy: Algorithms and Applications. (Dual-listed with 576.) (3-1) Cr. 3. Alt. S., offered 2000. *Prereq: Engl 105, Sp Cm 212, Com S 311 or M E 519, or consent of instructor.* Recent techniques for developing algorithms that automatically generate continuous motions while satisfying geometric constraints. Applications in areas such as robotics and graphical animation. Basic path planning. Kinematics, configuration space, and topological issues. Collision detection. Randomized planning. Nonholonomic systems. Optimal decisions and motion strategies. Coordination of Multiple Bodies. Representing and overcoming uncertainties. Visibility-based motion strategies. Implementation of software that computes motion strategies. Written reports. Nonmajor graduate credit.

Com S 481. Numerical Solution of Differential Equations and Interpolation. (Same as Math 481.) See *Mathematics*. Nonmajor graduate credit.

Com S 484. Advanced Digital Systems Design. (Same as Cpr E 484.) See *Computer Engineering*. Nonmajor graduate credit.

Com S 490. Independent Study. Cr. arr. F.S. *Prereq: 6 credits in computer science, permission of instructor.* No more than 9 credits of 490 may be counted toward graduation. Offered on a satisfactory-fail grading basis only. H. Honors

Com S 495. Seminar. Cr. arr. F.S. *Prereq: Permission of instructor.* Offered on a satisfactory-fail grading basis only.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Com S 507. Numerical Solution of Ordinary Differential Equations. (Same as Math 507.) See *Mathematics*.

Com S 509. Computational Methods of Linear Algebra. (Same as Math 509.) See *Mathematics*.

Com S 511. Design and Analysis of Algorithms. (3-0) Cr. 3. F. *Prereq: 311, 330.* A study of basic algorithm design and analysis techniques. Advanced data structures, amortized analysis, and randomized algorithms. Applications to sorting, graphs, and geometry. NP-completeness and approximation algorithms.

Com S 512. Formal Methods in Software Engineering. (3-0) Cr. 3. S. *Prereq: 311, 330.* A survey of formal topics relevant to the software life-cycle process including requirements, specifications, design, implementation, testing, and maintenance. Implications of formal results for software prototyping and automated testing.

Com S 524. Computer System Architecture. (3-0) Cr. 3. F. *Prereq: 352, or Cpr E 305.* Fundamentals of computer design, performance and cost, instruction set design, basic processor implementation techniques, pipelining, memory design, caches, I/O systems, multiprocessor systems, interconnection networks.

Com S 525. Numerical Analysis of High Performance Computing. (Same as Cpr E 525, Math 525.) See *Computer Engineering or Mathematics*.

Com S 526. Practical Introduction to Parallel Programming. (Same as Cpr E 526.) (3-1) Cr. 3. F. *Prereq: 321 and 311 or equivalent.* Fundamentals of parallel programming, design and analysis of parallel programs, survey of parallel programming environments for developing large-scale applications. The course will have a laboratory component to provide practical experience on different types of parallel computing platforms.

Com S 531. Theory of Computation. (3-0) Cr. 3. S. *Prereq: 331.* A systematic study of the fundamental models and analytical methods of theoretical computer science. Computability, the Church-Turing thesis, decidable and undecidable problems, and the elements of recursive function theory. Time complexity, logic, Boolean circuits, and NP-completeness. Finite-state and pushdown computation.

Com S 540. Principles of Compiling. (Dual-listed with 440.) (3-1) Cr. 3. S. *Prereq: 331, 342, Engl 105, So Cm 212.* Implementation of programming languages, emphasizing project work to construct a compiler/interpreter for Java subset or similar language. Project uses compiler-generator tools and object-oriented software design and development. Topics covered: lexical, syntax and semantic analyses; syntax-directed translation; implementation of interpreters; code generation and optimization. Different projects will be assigned for 540 and 440. Written reports. Nonmajor graduate credit.

Com S 541. Programming Languages I. (3-1) Cr. 3. F. *Prereq: 342 or 440.* Survey of the goals and problems of language design. Formal and informal studies of a wide array of programming language features including type systems, naming, state, and control. Creative use of functional, object-oriented, declarative, concurrent, and other programming paradigms.

Com S 542. Programming Languages II. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: 440.* Compilation theory and techniques, emphasis on high-level software tools to facilitate compiler construction. Lexical analysis, parsing, attribute grammars, code generation and optimization for traditional and nontraditional languages and architectures.

Com S 552. Principles of Operating Systems. (3-0) Cr. 3. S. *Prereq: 352.* A comparative study of high-level language facilities for process synchronization and communication. Formal analysis of deadlock, concurrency control and recovery, and system performance. Protection issues including capability-based systems, access and flow control, encryption, and authentication.

Com S 554. Distributed and Network Operating Systems. (Dual-listed with 454, same as Cpr E 554.) (3-1) Cr. 3. Alt. S., offered 2001. *Prereq: 311, 352, Engl 105, Sp Cm 212.* Laboratory course dealing with practical issues of design and implementation of distributed and network operating systems and distributed computing environments (DCE). These include client server paradigm, inter-processes communications, layered communication protocol, synchronization and concurrency control, and distributed file systems. Graduate credit requires additional in-depth study of advanced operating systems. Written reports. Nonmajor graduate credit.

Com S 561. Principles of Database Systems. (3-0) Cr. 3. S. *Prereq: 311 and 352.* Introduction to database system concepts. Physical data organization. The network model and the DBTG proposal. The hierarchical model. The relational model. Relational query languages. Functional dependencies. Multivalued dependencies. Decomposition of relation schemes. Normal forms. Query systems. Query optimization. Concurrency control. Distributed database systems.

Com S 572. Principles of Artificial Intelligence. (Dual-listed with 472.) (3-1) Cr. 3. F. *Prereq: 330 or Cpr E 310, Com S 342 or comparable programming experience.* Foundations, scope, and problems of artificial intelligence (AI) and cognitive science. State-space search techniques for problem solving.

Knowledge representation and automated inference. Machine learning. Neural and evolutionary approaches to AI. Artificial life. Selected applications in planning, machine perception, analysis, design, intelligent agent architectures. AI programming using Common LISP. Graduate credit requires a research project and a written report.

Com S 576. Motion Strategy: Algorithms and Applications. (Dual-listed with 476.) (3-1) Cr. 3. Alt. S., offered 2000. *Prereq: Engl 105, Sp Cm 212, Com S 311 or M E 519, or consent of instructor.* Recent techniques for developing algorithms that automatically generate continuous motions while satisfying geometric constraints. Applications in areas such as robotics and graphical animation. Basic path planning. Kinematics, configuration space, and topological issues. Collision detection. Randomized planning. Nonholonomic systems. Optimal decisions and motion strategies. Coordination of multiple bodies. Representing and overcoming uncertainties. Visibility-based motion strategies. Implementation of software that computes motion strategies. Written reports. Nonmajor graduate credit.

Com S 586. Computer Network Architectures. (3-0) Cr. 3. F. *Prereq: 511, 552 or Cpr E 489.* Design and development of advanced computer communication networks: distributed and failsafe routing in large and dynamic networks, gateways and interconnection of heterogeneous networks, flow control and congestion avoidance techniques, network architectures, communication protocol standards, formal specification and verification of protocols, implementation and conformance testing of protocol standards, network partitioning and intelligent reconfiguration of networks.

Com S 590. Special Topics. Cr. arr. *Prereq: Permission of instructor.* Offered on a satisfactory-fail grading basis only.

Com S 591. Graduate Orientation Seminar. (1-0) Cr. 1. F. *Prereq: Graduate classification.* Topics include an introduction to ISU computing facilities, M.S. and Ph.D. degree requirements, career choices, ethics, literature searching, technical presentations, technical writing, ethics in writing, and discussion of research interests and projects by members of the graduate faculty. Required by the M.S. degree and is taken during the first semester of a normal M.S. program. Offered on a satisfactory-fail grading basis only.

Com S 594. Introduction to Computational Molecular Biology. (Same as Gen 594.) See *Genetics*.

Com S 599. Creative Component. Cr. arr. Offered on a satisfactory-fail grading basis only.

Courses for Graduate Students

Com S 610. Seminar. Cr. arr. Offered on a satisfactory-fail grading basis only.

Com S 611. Advanced Topics in Analysis of Algorithms. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: 511, 531.* Advanced algorithm analysis and design techniques. Graph algorithms, algebraic algorithms, NP-completeness, probabilistic and parallel algorithms, intractable problems.

Com S 612. Parallel and Distributed Algorithms. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 511 or 531.* An advanced course in the theory of parallel and distributed computation. Models of computation, Algorithm paradigms and analysis, Lower bounds and impossibility results. Parallel sorting, graph, geometric, algebraic and number-theoretic algorithms. The parallel computation Thesis. P-complete problems and the class NC. Synchronous, asynchronous, partially timed distributed systems. Consensus, mutual exclusion, and resource allocation. Wait-free register implementations. Shared memory and network models. Fault-tolerance. Randomized computation.

Com S 624. Advanced Topics in Computer Architecture. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 524. Current topics in computer architecture design and implementation. Advanced pipelining, cache and memory design techniques. Interaction of algorithms with architecture models and implementations. Tradeoffs in architecture models and implementations.

Com S 625. Issues in Parallel Programming and Performance. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 511, 524. Parallel solutions of numerical and non-numerical problems, implementation of parallel programs on parallel machines, performance and other computational issues in parallel programming.

Com S 631. Computational Complexity. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 531. Advanced study in the quantitative theory of computation. Time and space complexity of algorithmic problems. The structure of P, NP, PH, PSPACE, and other complexity classes, especially with respect to resource-bounded reducibilities and complete problems. Complexity relative to auxiliary information, including oracle computations and relativized classes, randomized algorithms, advice machines, and Boolean circuits. Kolmogorov complexity and randomness.

Com S 632. Circuit Complexity and Parallel Complexity. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 531. An advanced course in the complexity of Boolean functions and parallel computation. General circuits, bounded-depth circuits, threshold circuits, and monotone circuits. Parallel complexity, including uniform circuits, alternating Turing machines, and parallel RAMs. Additional topics chosen from communication and sorting networks, communication complexity, VLSI complexity, cellular automata, neural networks, and general purpose parallel architectures.

Com S 633. Randomness in Computation. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 531. Advanced study of the role of randomness in computation. Randomized algorithms, random oracles, and probabilistic complexity classes. One-way functions and pseudorandom generators. Kolmogorov complexity, algorithmic information theory, and algorithmic randomness. Applications chosen from cryptography, interactive proof systems, computational learning, lower bound arguments, mathematical logic, and the organization of complex systems.

Com S 641. Semantic Models for Programming Languages. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 531, 541. Interpretive, denotational, and logically based models of semantics; application of semantics to program correctness, language specification, and translation.

Com S 652. Topics in Distributed Operating Systems. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 552. Concepts and techniques for network operating systems: high-level languages and communication protocols, name and object management, concurrency control for consistent distributed data, design of reliable software, protection, performance analysis.

Com S 661. Advanced Topics in Database Systems. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 561. Advanced topics chosen from the following list: Data dependencies. Data models. Query systems. Query optimization. Null values, partial information and database semantics. Acyclic database schemes. Concurrency control mechanisms. Distributed database systems. Logic and databases.

Com S 672. Computational Models of Learning. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 572 or 472 or 474. Advanced study of artificial intelligence, neural, statistical, syntactical, evolutionary models and algorithms for machine learning. Inductive learning, classification, grammar induction, function approximation, program induction, inductive logic programming. Computational learning theory (PAC, maximum likelihood, minimum description length and related frameworks). Deductive learning, reinforcement learning, discovery and data mining. Selected applications.

Com S 673. Advanced Topics in Artificial Intelligence and Cognitive Modeling. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 572 or 472 or 474. Advanced study of selected topics from among the

following: machine learning; neural networks; genetic algorithms, genetic programming, artificial life; intelligent agent architectures and robotics; cognitive modeling; computational learning theory; parallel and distributed architectures and algorithms for artificial intelligence.

Com S 699. Research. Offered on a satisfactory-fail grading basis only.

Construction Engineering

(Administered by the Department of Civil and Construction Engineering)

Mark O. Federle, Professor in Charge

Professors (Emeritus): Jellinger

Associate Professors: Federle, Jaselskis, Rowings, Smith

Associate Professors (Emeritus): Chase, Ward

Assistant Professors: Jahren

Undergraduate Study

For undergraduate curriculum in construction engineering leading to the degree bachelor of science, see *College of Engineering, Curricula*. This curriculum is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

Construction engineering is a curriculum administered by the Department of Civil and Construction Engineering. For details of the curriculum in construction engineering leading to the degree bachelor of science, see the *College of Engineering, Curricula*. General objectives, which are common to all departments in engineering, are stated in the *College of Engineering, Objectives of Curricula in Engineering*. The curriculum in construction engineering is designed with the objective to prepare students for life-long careers in the constantly changing technical and managerial environment of the construction industry. Students who successfully complete the curriculum will be prepared for entry into the field or for further study at the graduate level in construction engineering or related fields of study, such as law, business and other engineering disciplines.

Construction engineers need to possess strong fundamental knowledge of engineering design and management principles, including knowledge of business procedures, economics, and human behavior. Graduates of this curriculum may expect to engage in design of temporary structures, coordination of project design, systems design, cost estimating, planning and scheduling, company and project management, materials procurement, equipment selection, and cost control. With the emergence of design-build construction, the role of the construction engineer is expanding the need for trained professionals that understand both aspects of the project delivery environment. The curriculum offers opportunities to study emphases concerned with build

ing, heavy, or mechanical/electrical construction.

The process of construction involves the organization, administration, and coordination of labor resource requirements, temporary and permanent materials, equipment, supplies and utilities, money, technology and methods. These must be integrated in the most efficient manner possible to complete construction projects on schedule, within the budget, and according to the standards of quality and performance specified by the project owner or designer. The curriculum blends engineering, management and business sciences into a study of the processes of construction whereby designer's plans and specifications are converted into physical structures and facilities. To achieve this, a construction engineer must have:

- a broad foundation in mathematics and physical sciences.
- a base of knowledge in civil engineering discipline areas of surveying, geotechnical/materials, structures, and environmental/water resources.
- a base of knowledge in construction process designs, cost estimating, planning and scheduling.
- a basic knowledge of contracts, law, business organization, and principles of management.
- effective oral, written, and graphical communication abilities to effectively communicate with engineers and non-engineers.
- basic skills in the use of computers for communication, design, problem-solving, and analysis.

The curriculum develops the ability of students to be team workers, creative thinkers, and effective communicators. This is achieved by providing:

- opportunities for students to interact with practicing professionals.
- internships, cooperative education, study-abroad, and other meaningful employment that emphasized the knowledge required of a construction engineer.
- student organizations and classroom activities to develop leadership skills.
- opportunities to develop, analyze, and interpret alternative solutions to open-ended problems.

The construction industry is an increasingly global activity. Courses in humanities, social sciences, U.S. diversity, and international perspectives are included in the curriculum to broaden the student's perspective of the work environment. In addition, the department has several exchange program opportunities for students to participate in study-abroad programs. Interested and qualified students have the opportunity to participate in the cooperative education program or internship program to supplement academic work with work experience. See *Cooperative Education Programs, College of Engineering*.

Construction engineering students are encouraged to participate in life-long learning, continuous professional development, and to achieve either professional engineer registration or certified professional constructor.

Graduate Study

An area of specialization in construction engineering is offered within the graduate program of the Department of Civil and Construction Engineering. See *Civil Engineering, Courses and Programs*.

Courses are offered for minor work to students taking major work in other curricula or in interdepartmental programs.

Courses open for nonmajor graduate credit: 340, 380, 421, 441.

Courses Primarily for Undergraduate Students

Con E 110. Introduction to Construction Engineering. (1-4) Cr. R. S. 5 weeks. The nature and scope of the construction industry. Overview of the profession and education for the constructor. Saturday field trip. Field trip fee, materials fee.

Con E 220. Construction Management. (3-0) Cr. 3. F.S. *Prereq:* *Engr 160 or 161*. To develop working knowledge of the construction industry for the design professional. The topics covered represent the major topics that define the roles and responsibilities of the design professional working in the industry. The topics covered include: the construction industry, project delivery system, construction contracts, construction insurance and bonds, safety, labor relations, project administration.

Con E 221. Contractor Organization and Management of Construction. (4-0) Cr. 4. F.S. *Prereq:* *Completion of basic program and Engr 170*. Entry level course for construction engineering; integration of significant statistical, engineering, economics, and management issues related to efficient construction company operations. Probability and statistics; time value of money; methods of evaluating alternative projects; organization; operations; construction company administration; marketing; insurance and bonding; project safety; labor law; productivity; total quality management; and motivation and leadership.

Con E 241. Construction Materials and Methods. (2-3) Cr. 3. F.S.SS. *Prereq:* 221. Introduction to materials and methods of building construction and to construction drawings. Foundation, structural framing, floor, roof, and wall systems. Mechanical and electrical installations. Blueprint reading and quantity takeoff techniques. Field trip fee. Materials fee.

Con E 245. Construction Contract Documents. (2-0) Cr. 2. F.S.SS. *Prereq:* 221. Definition, interpretation, and utilization of drawings, specifications, agreements, bidding forms, general conditions, bonds, subcontracts, shop drawings, and related documents. Materials fee.

Con E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of department chair; sophomore classification*. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Con E 322. Construction Equipment and Heavy Construction Methods. (2-3) Cr. 3. F.S. *Prereq:* 241. Selection and acquisition of construction equipment. Application of engineering fundamentals and economics to performance characteristics and production of equipment. Heavy construction methods and economic applications. Field trip fee. Materials fee.

Con E 340. Concrete and Steel Construction. (2-3) Cr. 3. F.S. *Prereq:* *Credit or enrollment in 322, E M 324*. Planning and field engineering for concrete and steel construction. Design and applications of concrete formwork to construction. Erection of structural steel. Field trip fee. Materials fee. Nonmajor graduate credit.

Con E 351. Mechanical and Electrical Systems for Buildings. (3-2) Cr. 4. F.S. *Prereq:* 241, *Phys 222*. Comprehensive coverage of the major building systems including mechanical systems, electrical systems, plumbing, fire protection, security, vertical transportation, lighting, acoustics and communications. The course will include analysis techniques

and design principles for each system. A comprehensive design project is required for a major building project. Field trip fee, materials fee.

Con E 380. Engineering Law. (3-0) Cr. 3. F.S. *Prereq:* *Junior classification*. Introduction to law and judicial procedure as they relate to the practicing engineer. Contracts, professional liability, professional ethics, licensing, bidding procedures, intellectual property, products liability. Emphasis on development of critical thinking process, abstract problem analysis and evaluation. Nonmajor graduate credit.

Con E 396. Summer Internship for International Students. Cr. R. SS. *Prereq:* *Permission of department*. Summer professional work period for international students.

Con E 397. Engineering Internship. Cr. R. F.S.SS. *Prereq:* *Permission of department*. Professional work period, one semester maximum per academic year.

Con E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of department chair; junior classification*. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Con E 410. Professional Development. (1-0) Cr. 1. F. *Prereq:* *Senior classification in construction engineering*. Employment opportunities, résumé preparation, job search, and interviewing. Professional registration and ethics, current industry issues, safety, professional and industry associations. Field trip fee.

Con E 421. Construction Estimating. (2-2) Cr. 3. F.S. *Prereq:* 340, 380, 245. Conceptual estimating. Bid preparation for buildings, highways, heavy, mechanical trades. Estimating costs for material, labor, equipment, overhead, and profit. Quantity surveys, unit costs, production rates, and pricing methods. Subcontract bid analysis and bid procedure. Cost analysis and cost control. Field trip fee. Materials fee. Nonmajor graduate credit.

Con E 441. Construction Planning, Scheduling, and Control. (1-2) Cr. 2. F.S. *Prereq:* *Credit or enrollment in 421*. Integration of previous construction coursework into the planning, scheduling, and management of time, costs, and other resources. Emphasis on preparation and analysis of network schedules. Comprehensive planning and scheduling project. Computer applications. Field trip fee. Materials fee. Nonmajor graduate credit.

Con E 461. Construction Engineering Design. (1-9) Cr. 4. F.S. *Prereq:* 441, *student must be within two semesters of graduating*. Application of team design concepts to a construction engineering project. Conceptual planning. Detailed analysis. Advanced cost and schedule applications. Contract negotiation. Development of a complete project history. Technical presentations (oral and written). Field trip fee, materials fee.

Con E 490. Independent Study. Cr. 1 to 5 each time taken. F.S.SS. *Prereq:* *Permission of professor in charge*. Individual study in any phase of construction engineering. Pre-enrollment contract required.

Con E 495. Research Methods in Construction Engineering and Management. (1-0) Cr. 1. F. *Prereq:* *Credit or enrollment in Con E 421*. Assigned readings and reports on research methods to solve construction engineering and management problems such as robotics, project controls, automation, etc. Identification of research methods and priorities, selection and development of research design, and critique of research in construction engineering and management.

Con E 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of department chair; senior classification*. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Criminal Justice Studies

(Interdepartmental Undergraduate Program)

Martin G. Miller, Program Coordinator

The criminal justice studies minor, a cross-disciplinary course of study in the College of Liberal Arts and Sciences, offers an opportunity for students to learn about the components of the criminal and juvenile justice systems, to become acquainted with the issues and problems affecting these systems, to apply theoretical concepts to real world problems, and to plan a career in criminal or juvenile justice.

Students who declare a minor in criminal justice studies are required to complete an orientation course, a professional seminar, a core curriculum, and a practicum. Students should contact the program coordinator for information and program planning.

Courses open for nonmajor graduate credit: 332.

Primary Courses

CJ St 201. Orientation to the Criminal and Juvenile Justice Systems. Cr. R. F. *Prereq:* *Freshman or sophomore classification*. Various components of the criminal and juvenile systems. Opportunities, challenges, and preparation of a criminal justice professional. Guest speakers and field trips. Offered on a satisfactory-fail grading basis only.

CJ St 241. Youth and Crime. (Same as Soc 241.) See *Sociology*.

CJ St 320. American Judicial Process. (Same as Pol S 320.) See *Political Science*.

CJ St 332. Philosophy of Law. (Same as Phil 332.) See *Philosophy*. Nonmajor graduate credit.

CJ St 340. Deviant and Criminal Behavior. (Same as Soc 340.) See *Sociology*.

CJ St 341. Criminology. (Same as Soc 341.) See *Sociology*.

CJ St 401. Professional Seminar in Criminal and Juvenile Justice. Cr. R. S. *Prereq:* *Senior classification*. Critical analysis of professional, ethical, and public issues affecting criminal and juvenile justice systems. Survey of current professional opportunities and preparation for the job search process. Offered on a satisfactory-fail grading basis only.

CJ St 460. Criminal and Juvenile Justice Practicum. (Same as Soc 460.) See *Sociology*.

Curriculum and Instruction

Gary E. Downs, Interim Chair of Department

Professors: Abelson, Andre, Brun, Carter, Dake, Downs, Duffelmeyer, Greenbowe, Keller, Knaphus, Martin, McCormick, Messenger, Miller, Owen, Rudolph, Tanner, Thompson, D. Williams, S. Williams, Willis

Distinguished Professors (Emeritus): Moyer, Rasmussen

University Professors (Emeritus): Brown

Professors (Emeritus): Barnhart, Bath, Baum, Beard, Breiter, Burkhalter, Charles, Coulson, Daly, Dilts, Henney, Hoerner, Hunter, Kahler,

Schloerke, Schneider, Thomas, Volker, Zbaracki

Associate Professors: Allen, Amos, Blount, Carlson, Deluca, Hand, Hausafus, Kelly, Merkley, Miller, Payne, Phye, Schilling, Sharp, Stuart, Torrie

Associate Professors (Emeritus): Ebert

Assistant Professors: Andreotti, Bloom, Donaldson, Foegen, Hargrave, Keller, Koeppen, Leigh, McMurray-Schwarz, Munsen, Tartakov

Assistant Professors (Adjunct): Rieck, Rosenbusch, Schmidt, Sommerville, Whigham

Instructors: Kearney, Nonis

Instructors (Adjunct): Connor, Killmer

Undergraduate Study

The Department of Curriculum and Instruction provides the professional education coursework that leads to licensure of pre-service teachers. Students major in elementary education for K-6 teaching licensure or early childhood education for a birth through third grade license. Secondary licensure students major in their respective content areas. Early childhood education and elementary majors must complete a professional course sequence: C I 201, 204, 333, and 406.

Graduates of the elementary education program will be able to demonstrate through professional practice their understanding of academic disciplines, teaching and learning, the nature of the child, and how to adapt instruction to diversity. More specifically, graduates will be able to demonstrate their understanding of concepts and structures of disciplines, tools of inquiry, how children learn and develop, and the effects of individual differences on learning. Graduates will be able to demonstrate a broad range of instructional strategies, including knowledge of technology applicable to instruction. In their teaching, graduates will demonstrate the ability to stimulate active inquiry with collaboration and supportive interaction among their students. In appropriate settings graduates will demonstrate their ability to develop professional relationships with colleagues, parents, and agencies that support students and their learning.

Early Childhood Education

The curriculum in early childhood education is planned for students preparing to teach young children and work with their families. This program leads to careers in working with young children who are typically developing and those with special needs from birth through age eight. Graduates in this curriculum may teach in early childhood (preschool and primary) classrooms or home based programs, with emphasis on inclusive services; graduates may be employed by either public or private agencies including schools. The program is administered jointly by the Department of Curriculum and Instruction in the College of Education and the Department of Human Development and Family Studies in the College of Family and Consumer Sciences.

Elementary Education

For the undergraduate curriculum in elemen-

tary education, leading to the degree bachelor of science, see *Education Curriculum*.

The curriculum in elementary education is planned for persons who want to teach at the elementary school level. Endorsements in mathematics and multicategorical resource teaching are available for elementary education students. An endorsement for teaching foreign language in elementary schools is available through the Department of Foreign Languages and Literatures. Students who enroll in elementary education must make application to and be accepted by the departmental teacher education committee and the University Teacher Education Committee, prior to enrolling in advanced elementary education courses. For admission and licensure requirements, see *College of Education*.

Secondary Education

Students seeking recommendations for a license to teach in the secondary schools must be admitted to the teacher education program and pursue a program that includes the following: C I 201, 204, 333, 406, 426; special methods; and student teaching in the area of specialization.

All students who are recommended by Iowa State University for teacher licensure must meet the requirements of the teacher education program and be recommended by the College of Education. Each student will be enrolled in the department in which he or she plans to major, and must meet the graduation requirements of that department and the college in which it is located. For specific requirements for each area of specialization, see Teacher Education and curricula for the college in which the chosen degree major is sought.

The section offers a minor in educational computing that may be earned by completing the following courses: C I 201; Com S 107 or Com S 207 or Cpr E/Mat E 370; C I 280B; 302; 403; and 407.

Graduate Study

The Departments of Curriculum and Instruction and Educational Leadership and Policy Studies offer work for the degrees master of science, master of education, and doctor of philosophy with a major in education and minor work to students taking major work in other departments. Within the education major in the Department of Curriculum and Instruction a student may earn an education degree with no area of specialization (master's and doctorate) or specialize in elementary education (master's only), special education (master's only), or curriculum and instructional technology (master's and doctorate). A professional certificate program in special education is available to graduate students who seek a teaching endorsement in special education, but do not wish to pursue a master's degree. See *Educational Leadership and Policy Studies* for further discussion of the education major with specialization in adult and extension education; counselor education; educational administration; higher education; historical, philosophical, and comparative studies in education; and research and evaluation.

Students may choose an area of specialization for study. Available areas include curriculum and instructional technology, elementary education, and special education. The specialization in curriculum and instructional technology is designed to prepare candidates as researchers and practitioners in the fields of curriculum and instructional technology. The specialization in elementary education is designed to prepare candidates for teaching and curricular leadership positions in elementary settings. The special education specialization is designed to prepare candidates as practitioners and researchers in the field of mild disabilities. Graduate endorsement programs in learning disabilities, behavioral disorders, multicategorical education, special education consultant, and K-12 school media specialist are administered through the Department of Curriculum and Instruction. Students may also opt not to select an area of specialization.

Prerequisite to major graduate work in education is preparation substantially equivalent to the completion of one of the undergraduate curricula in education offered at Iowa State University, or graduate preparation in a discipline to be used as a teaching field in a community college or university, and adequate proof that the student ranks above average in scholastic ability and promise of professional competence.

The foreign language requirement, if any, for the Ph.D. degree will be determined by the student's program of study committee. If no foreign language is required, the total program must consist of a minimum of 78 semester credits, at least 12 of which must be earned outside the education major, and at least 16 of which must be earned outside the area of specialization. Statistics and research methods may not be included in the 16 credits. Should foreign language be included, the program of study committee may adjust the minimum program requirement downward, but in no instance may the program of study be less than 72 semester credits. Students whose native language is not English may substitute competence in English. All applicants for the Ph.D. must submit Graduate Record Examination (GRE) scores.

Other graduate programs related to education (including General Graduate Studies) may be planned for students on the basis of previous education and experiences as well as future plans and needs. Students should refer to Agricultural Education and Studies, Family and Consumer Sciences Education, Health and Human Performance, Industrial Technology, Educational Leadership and Policy Studies, and General Graduate Studies or to graduate level course offerings within other departments.

Courses open for nonmajor graduate credit: C I 407, 430, 457; Sp Ed 457.

Curriculum and Instruction (C I)

Courses Primarily for Undergraduate Students

C I 115. First Year Orientation. Cr. R. F.S. Overview of elementary education, curricular opportunities, transitions to college and community life, and university procedures. Required of all freshmen majoring in

elementary education. Offered on a satisfactory-fail grading basis only.

C I 201. Introduction to Instructional Technology. (2-2) Cr. 3. Overview of instructional technology, with an emphasis on uses in education. Instructional applications of computers for computer-based learning including tool software, interactive multimedia, use of digital video and sound, graphics, compact discs, and laser discs. Pedagogical considerations in the use of technology. Preparation of teaching materials. Laboratory work with hardware and software that facilitate teaching and learning. Materials fee.

C I 204. Social Foundations of American Education. (3-0) Cr. 3. F.S.SS. Goals of schooling, including the roles of teachers today; historical development of schools; educational reforms and alternative forms; and current philosophical issues. Human relations aspects of teaching and discussions about teaching as a career.

C I 215. Sophomore Orientation. Cr. R. F.S. Review of elementary education requirements. Program planning. Required of all sophomores majoring in elementary education. Offered on a satisfactory-fail grading basis only.

C I 245. Strategies in Teaching. (2-0) Cr. 2. F.S.SS. *Prereq:* 204, *concurrent enrollment in 268; eligibility for admission to teacher education program.* Introduction to elementary education teaching strategies, classroom management, and curriculum organization. Open to students in the elementary education curriculum or the early childhood education curriculum only.

C I 250. Education of the Exceptional Learner in a Diverse Society. (Same as Sp Ed 250.) See *Special Education*.

C I 268. Strategies Practicum. (0-2) Cr. 1. F.S.SS. *Prereq:* 204. Clinical experience, to be taken concurrently with 245. Offered on a satisfactory-fail grading basis only.

C I 280. Pre-Student Teaching Experience. Cr. 0.5 to 2 each time taken, maximum of 8 credits. F.S.SS. 280A may be taken alone. For enrollment in 280B-I, 280A must be either a prerequisite or taken concurrently. Field experience in area educational settings. 2-hour blocks of time needed for field experience. Offered on a satisfactory-fail grading basis only.

A. Teacher Aide. Cr. 1 or 2.
B. Educational Computing. Cr. 1 or 2. (2 credits by permission only).
C. Native American Tutoring. Cr. 1.
D. Museum Education. Cr. 1.
E. Multicultural Youth Experience. Cr. 1 to 2
F. International Student. Cr. 1 or 2. (Permission of instructor required.)
G. Gifted and Talented Students. Cr. 1.
I. Multicategorical. F. Cr. 1 (concurrent with Sp Ed 330).

C I 281. The Special Needs Student Experience. (0-4) Cr. 2 each time taken, maximum of 6 credits. F.S.SS. Seminars and visits to public schools serving special students. One week practicum at the Iowa School for the Deaf, the Iowa Braille and Sight Saving School, and State Mental Health Institutes. Offered on a satisfactory-fail grading basis only.

C I 282. The Urban Student Experience. (0-2) Cr. 1 or 2 each time taken, maximum of 4 credits. F.S.SS. Seminars and visits to urban schools and to organizations serving urban students. Offered on a satisfactory-fail grading basis only.

C I 290. Independent Study. Cr. 1 to 3. *Prereq:* 6 credits in education, permission of department head.

C I 302. Using Computers in the Classroom. (2-2) Cr. 3. F.S. *Prereq:* 201 or Com S 107. Integrating computer applications into the curriculum; designing classroom applications for tool software; selecting and evaluating software for the classroom; issues and trends in computer based instruction.

C I 315. Transfer Orientation. Cr. R. F.S. Overview of elementary education requirements, curricular opportunities, and university procedures. Program planning. Required of all transfer students majoring in elementary education. Offered on a satisfactory-fail grading basis only.

C I 333. Educational Psychology. (Same as Psych 333). (3-0) Cr. 3. F.S.SS. *Prereq:* 201, *Psych 230 or HD FS 102, application to the teacher education program or major in psychology.* Classroom learning with emphasis on cognitive development, cognitive learning theory, and instructional techniques. Major emphasis on measurement theory and the classroom assessment of learning outcomes.

C I 367. Teaching Literacy in the Primary Grades. (4-0) Cr. 4. F. *Prereq:* 245, 250, *HD FS 221, 240; admission to teacher education; concurrent enrollment in 468F, Sp Ed 368, HD FS 343.* Theories, teaching strategies, materials, and learning experiences for kindergarten through third grade students. Formal and informal assessment strategies and instructional methods for diverse learners.

C I 377. The Teaching of Reading and Language Arts in the Primary Grades (K-3). (4-0) Cr. 4. *Prereq:* 245, 250, *HD FS 226, 240; admission to teacher education program; concurrent enrollment in 468A.* Emergent literacy theories, teaching strategies, materials, and learning experiences, with a balance between teacher-directed explicit instruction and learner-directed discovery.

C I 378. The Teaching of Reading and Language Arts in the Intermediate Grades (4-6). (4-0) Cr. 4. *Prereq:* 377; *concurrent enrollment in 468B and 443.* Theories and processes of literacy. Application through reading and writing across the curriculum, integration of language arts, literature-based instruction, and metacognitive strategies.

C I 395. Teaching Reading in Middle and Secondary Schools. (3-0) Cr. 3. F.S. and Alt. SS., offered 2001. *Prereq:* 204. Analysis and application of strategies to enhance students' literacy development.

C I 403. Design and Development of Computer-based Learning. (2-2) Cr. 3. S. *Prereq:* 302. Application of principles of instructional development and learning theory to development of interactive multimedia. Selection, use, troubleshooting, and maintenance of multimedia equipment. Analysis of research related to effective instructional use of interactive multimedia.

C I 406. Multicultural Nonsexist Education. (2-0) Cr. 2. F.S.SS. *Prereq:* 201, 333, *junior classification, admission to teacher education program.* Awareness and nature of cultural pluralism; need for multicultural nonsexist education; multicultural concepts and theories; cultural groups- their perceptions, needs, and contributions; problems and issues regarding ethnocentrism, prejudice, and discrimination based on race, class, sex/gender, and language in the school environment; curriculum infusion and transformation, multicultural nonsexist interaction, design and execution of teaching strategies.

C I 407. Principles and Practices of Distance Education. (Dual-listed with 507.) (2-0) Cr. 2. F.SS. Principles, technologies, and techniques for teaching and learning in a distance education system. Research on distance education. The Iowa Communications Network. Nonmajor graduate credit.

C I 415. Senior Seminar. Cr. R. F.S.SS. *Prereq:* *Senior classification, admitted to teacher education program, concurrent enrollment in 426.* Overview of requirements for teacher certification in Iowa and other states; functions of Education Student Services examined; interviewing procedures.

C I 416. Supervised Student Teaching. Cr. var. F.S. *Prereq:* *GPA 2.5; full admission to teacher education; senior classification: 201, 378, 443, 448, 449; reservation required.* Supervised teaching experience in the elementary grades.

- A. Primary grades.
- B. Intermediate grades.
- C. Foreign Languages.
- D. International Student Teaching.

C I 417. Student Teaching. (Same as LAS 417.) See *Liberal Arts and Sciences Cross-Disciplinary Studies*.

C I 422. Reading and Language Arts Instruction Using Technology. (3-0) Cr. 3. S.SS. *Prereq:* 201, 377. Methods and strategies used to integrate computer-related technologies into the reading and lan-

guage arts curriculum. Use and evaluation of reading and language arts software in elementary classrooms.

C I 426. Principles of Secondary Education. (3-0) Cr. 3. F.S.SS. *Prereq:* 201, *senior classification, admitted to teacher education program, concurrent enrollment in 415.* The curriculum, how to make accommodations for students with special needs, human relations, student evaluation, support services, classroom management, organization of schools, legal aspects of schools, professionalism, and career planning. A planned field experience is a professional growth activity included in the course. Students often enroll in 480 concurrently with this course.

C I 427. Project Opportunity Capstone. (2-0) Cr. 2. S. Issues in education as related to beginning teachers: assessment, classroom management, law, special education, effective teaching, reflectivity, technology. Offered on a satisfactory-fail grading basis only.

C I 430. Psychology of Adolescence. (Same as Psych 430.) (3-0) Cr. 3. *Prereq:* 2 courses in *psychology including 230.* Contemporary research and theory concerning psychological processes that influence development during adolescence. Implications for facilitating adolescents' development in various settings. Nonmajor graduate credit.

C I 433. Teaching Social Studies in the Primary Grades. (2-0) Cr. 2. S. *Prereq:* 367, *HD FS 221; concurrent enrollment in 438, 439, Sp Ed 355, 455.* Study, development, and application of current methods for providing appropriate social studies learning experiences for primary grade children. Instructional strategies, curriculum content, and formal and informal assessment strategies for diverse learners.

C I 438. Teaching Mathematics in the Primary Grades. (2-0) Cr. 2. *Prereq:* 367, *HD FS 221; Math 195; concurrent enrollment in 433, 439, 468G, Sp Ed 355, 455.* Study, development, and application of current methods for providing appropriate mathematics learning experiences for primary grade children. Formal and informal assessment strategies and instructional methods for diverse learners.

C I 439. Teaching Science in the Primary Grades. (2-0) Cr. 2. S. *Prereq:* 367, *HD FS 221; concurrent enrollment in 433, 438, 468I, Sp Ed 455.* Study, development, and application of current methods for providing appropriate science learning experiences and processes for primary grade children. Formal and informal assessment strategies and instructional methods for diverse learners.

C I 443. The Teaching of Social Studies. (3-0) Cr. 3. F.S.SS. *Prereq:* *Concurrent enrollment in 378.* Study, development, and application of current methods, curriculum materials, and assessment strategies for providing appropriate social studies learning experiences for primary and intermediate grade children.

C I 448. Teaching Children Mathematics. (3-0) Cr. 3. F.S.SS. *Prereq:* 377, *concurrent enrollment in 449 and 468C, junior classification, Math 195.* Study, development, and application of current methods for providing appropriate mathematical learning experiences for primary and intermediate children. Inclusion of formal and informal assessment strategies and instructional methods for diverse learners.

C I 449. The Teaching of Science. (3-0) Cr. 3. F.S.SS. *Prereq:* 377, *concurrent enrollment in 448 and 468D, junior classification.* Procedures for teaching science to children. Emphasis on developmental implications, teaching processes, teaching methods, discovery-inquiry approach, and current programs.

C I 450. Ethnicity and Learning. (3-0) Cr. 3. F.S. *Prereq:* 245. Examination of cultural relevance in education. Development and application of strategies and techniques for implementing multicultural goals and multi-ethnic perspectives in the elementary school classroom setting.

C I 451. Ethnicity and Learning Practicum. (1-4) Cr. 3. *Prereq:* 450. Field experience in a multi-ethnic or ESL (English as a Second Language) classroom setting. Students must have one full day or two half days open each week in order to participate.

C I 457. Teaching Exceptional Learners in the Regular Classroom. (Same as Sp Ed 457.) See *Special Education*. Nonmajor graduate credit.

C I 468. Supervised Practicum in Teaching. Cr. 0.5 to 1. F.S.SS. *Prereq:* 245, 250, 268, admission to teacher education program. Observation, application of current methods, and instructional experiences with children in a supervised elementary classroom while engaged in other elementary methods courses. Field trip fee. Offered on a satisfactory-fail grading basis only.

- A. Primary Grades, Reading and Language Arts. Cr. 1.
- B. Intermediate Grades, Reading and Language Arts. Cr. 1.
- C. Mathematics. Cr. 0.5. (0.5 or 1 in summer only)
- D. Science. Cr. 0.5. (0.5 or 1 in summer only)
- E. Foreign Language. Cr. 1.
- F. Primary Grades, Literacy, Inclusive. Cr. 1.
- G. Primary Grades, Mathematics, Inclusive. Cr. 1.
- I. Primary Grades, Science, Inclusive. Cr. 1.

C I 478. Diagnosis and Correction of Reading Problems. (3-0) Cr. 3. F. *Prereq:* 378. Diagnosis of students with reading difficulties using formal, informal, and on-going assessment. Instructional strategies for mildly, moderately, and severely disabled readers.

C I 480. Field Experience for Secondary Teaching Preparation. (Same as LAS 480.) See *Liberal Arts and Sciences Cross-Disciplinary Studies*.

C I 486. Methods in Elementary School Foreign Language Instruction. (Same as F Lng 486.) See *Foreign Languages and Literatures*.

C I 487. Methods in Secondary School Foreign Language Instruction. (Same as F Lng 487.) See *Foreign Languages and Literatures*.

C I 490. Independent Study. Cr. 1 to 3. *Prereq:* GPA of 2.5 or more for preceding semester.

- A. Music Education. (Same as Music 490A.) See Music.
- B. Vocational and Educational Guidance
- C. Curriculum Construction
- D. Principles of Education
- E. Methods of Teaching
- F. Educational Psychology
- G. Instructional Technology
- H. Honors
- I. Foundations of Educational Statistics
- J. Multicultural Education
- K. Social Studies
- S. Foundations of Education

C I 491. Educational Inquiry. (2-0) Cr. 2. F. *Prereq:* Participation in Project Opportunity. Introduction to research terminology, qualitative and quantitative methodology, data collection techniques, and research resources to more closely link research and practice for prospective teachers. Includes a field-based research component to synthesize coursework, field experiences, and related research.

C I 492. Methods of Teaching Science. (Same as LAS 492.) See *Liberal Arts and Sciences Cross-Disciplinary Studies*.

C I 493. Methods of Teaching History/Social Sciences. (Same as LAS 493.) See *Liberal Arts and Sciences Cross-Disciplinary Studies*.

C I 494. Practice and Theory of Teaching Literature in the Secondary Schools. (Same as Engl 494.) See *English*.

C I 495B. Teaching Speech. (Same as Sp Cm 495B.) See *Speech Communication*.

C I 496. Elementary Education Seminar. Cr. 1 to 3. F.S.SS. A variety of topics concerned with elementary education. Topics vary each semester depending on issues explored. May be repeated. Offered on a satisfactory-fail grading basis only.

C I 497. Teaching of Secondary School Mathematics. (Same as Math 497.) See *Mathematics*.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

C I 501. Instructional Technology. (3-0) Cr. 3. F.S.SS. *Prereq:* Graduate classification. Principles of instructional technology for education and training. Utilization of technology for learning and teaching. Production of instructional materials. Application of research to the production and use of instructional technology. Methods of teaching and learning with technology. Equipment operation. Materials fee.

C I 502. Visual Media. Cr. 1 to 4. S. *Prereq:* 501. Principles of the design and production of instructional media. A series of one credit modules in instructional technology research, photography, instructional television, multimedia, Internet, and film. Laboratory experiences in the production of these media. Materials fee.

C I 503. Designing Instructional Systems. (3-0) Cr. 3. F. *Prereq:* 501. Introduction to models and theories of instructional design. Examination of models based on behavioral, information processing, and cognitive science theories. Emphasis on design based constructivist theories and interpretivist epistemologies.

C I 504. Managing and Evaluating Instructional Technology Programs. (3-0) Cr. 3. F. *Prereq:* Graduate classification. Principles and procedures for program review, assessment, and analysis of media/technology programs in education and corporate settings. Management theories and methods for planning, organizing, influencing, and operating the services and human resources in technology organizations. Facilities planning, promotion, and public relations. Principles of staff training, proposal development, and legal issues related to media/technology support services.

C I 505. Computer Applications in Education. (2-0) Cr. 2. F. *Prereq:* Graduate classification. Teaching and learning using computers. Selection and evaluation of software and hardware for teaching and learning. Research on computers. Tool software. Trends in computer-based instruction. Telecommunications.

C I 506. Multicultural Nonsexist Education in C Curriculum Development and Instruction. (3-0) Cr. 3. F.S.SS. *Prereq:* 6 graduate credits in education. Theories, legal bases, and principles of multicultural nonsexist education. Pluralism and contributing cultures in the United States; presence and contributions of cultural group diversity with implications for educational programs, curriculum development, classroom instruction, materials utilization and development; problems and issues, strategies and techniques; inquiry and research on multicultural nonsexist education issues.

C I 507. Principles and Practices of Distance Education. (Dual-listed with C I 407.) (2-0) Cr. 2. Principles, technologies, and techniques for teaching and learning in a distance education system. Research on distance education. The Iowa Communications Network.

C I 509. Applications of Geometry in the Elementary Classroom. (3-0) Cr. 3. *Prereq:* Teaching license. Euclidean and non-Euclidean geometry explorations with a focus on applying the foundation ideas of axiomatic structure and relationships with simple geometric ideas into an elementary classroom setting. Additional topics chosen from discrete mathematics, mathematics history, and fractal geometry will be used to facilitate critical examination of elementary curriculum, pedagogy, and assessment.

C I 510. Advanced Computer Applications in Education. (3-0) Cr. 3. S. *Prereq:* 505 or one college-level course in computer programming. Integrating computer software (word processors, spreadsheets, Logo, simulations, telecommunications) into the curriculum. Application of theories of learning. Computer mediated changes in roles of teachers and students.

C I 516. Antiracist Curriculum Development and Implementation. (2-2) Cr. 3. *Prereq:* 9 credits in education. Introduction to historical, sociological, philosophical and pedagogical foundations of

antiracist/multicultural education. Examination of causes of racism, other forms of discrimination, and intergroup conflict from different theoretical perspectives and experiential exercises.

C I 520. Teaching Strategies for Individualized Instruction. (2-0) Cr. 2. *Prereq:* 9 credits in behavioral sciences. Analysis of current trends and practices for individualizing instruction.

C I 521. Surveying Gifted Education. (3-0) Cr. 3. *Prereq:* 9 credits in education. Survey of major areas of concern in the field of education for the gifted. Includes definitions, program objectives, program types, teaching strategies, and tools.

C I 523. Corrective Mathematics. (3-0) Cr. 3. S.SS. *Prereq:* 448. Identification, analysis, and correction of mathematics problems within the elementary program with an emphasis on alternative teaching strategies and curriculum development.

C I 531. Research in Gifted Education. (2-0) Cr. 2. *Prereq:* 9 credits in education including one course in gifted education. Emphasis on research in teaching strategies, program development, and other areas of topical concern. Informal assessment instruments relating to educational programs.

C I 532. Methods, Models, and Materials for Teaching Gifted Children. (3-0) Cr. 3. *Prereq:* 9 credits in education including one course in gifted education. Teaching models and the methods and materials used with TAG students.

C I 533. Educational Psychology of Learning Cognition, and Motivation. (Same as Psych 533.) (3-0) Cr. 3. F.SS. *Prereq:* 333 or teacher licensure. Learning, cognition, and motivation in educational/training settings, instructional theory and models, individual differences and instructional process.

C I 535. Educational Psychology of Computer Applications. (3-0) Cr. 3. S. *Prereq:* 201, 533. Implications of cognitive and motivational processes for the design and development of computer applications in educational and training settings. Current research and theory across various topics, including adaptive instruction, problem solving, simulations, virtual environments, exploratory software, artificially intelligent instructional computing, computers as cognitive tools, and other contemporary topics.

C I 542. The Secondary School Curriculum. (2-0) Cr. 2. F.SS. *Prereq:* Teacher license. Curricular and co-curricular programs of secondary schools; recent trends in goals, content organization, and organization for instruction; local community resources as curriculum content.

C I 543. Teaching Science to Elementary School Students. (3-0) Cr. 3. *Prereq:* Teaching license. Critical examination of the discipline of science within the elementary school curriculum. Emphasis on content, assessment, and revision of science programs using current curriculum procedures.

C I 545. The Elementary School Curriculum. (2-0) Cr. 2. F.SS. *Prereq:* Teacher license. Curricular and co-curricular programs of elementary schools; recent trends in goals, content organization, and organization for instruction; local community resources as curriculum content.

C I 550. Current Trends and Issues in Elementary Education. (3-0) Cr. 3. *Prereq:* Teaching license. Focuses on the economics, social, and political trends and issues affecting instruction in elementary schools.

C I 551. Foundations of Reading and Language Arts. (3-0) Cr. 3. S.SS. *Prereq:* Teaching license. Analyzing, discussing, and researching the theory and practice of current literacy issues.

C I 552. Corrective Reading. (3-0) Cr. 3. F.SS. *Prereq:* One course in reading. Identification, analysis, and correction of reading problems within the elementary program in five areas: print knowledge, integration of print knowledge, oral reading fluency, vocabulary, and comprehension.

C I 553. Reading for Adolescents with Mild Disabilities. (Same as Sp Ed 553.) See *Special Education*.

C I 554. Reading and Responding to Children's Literature. (3-0) Cr. 3. *Prereq: Teaching license.*

Research and discussion of issues surrounding the use of current children's literature in the classroom, including censorship, diversity, and literature selection.

C I 556. Integrating Technology into the Reading and Language Arts Curriculum. (3-0) Cr. 3. *Prereq: Teaching license.* Application of current research and recommendations for integrating computer-related technologies into the reading and language arts curriculum. Use and evaluation of reading and language arts software for elementary classrooms.

C I 557. Supervised Tutoring in Reading. (2-2) Cr. 3. *Prereq: 552.* Using formal and informal diagnostic procedures to plan and implement individualized reading instruction. Field experience.

C I 558. Computer Supported Learning. (3-0) Cr. 3. F. *Prereq: 510.* Instructional computer applications, research, and theories. Design and development of computer based curriculum materials.

C I 559. Reading and Writing in the Content Areas. (3-0) Cr. 3. *Prereq: Teaching license.* Analysis of models and instructional strategies appropriate for developing literacy for middle and secondary school students across the curriculum.

C I 567. Principles of Corrective Mathematics for Secondary Teachers. (Same as Sp Ed 567.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: Secondary teaching experience.* Methodology for identification, analysis, and correction of secondary students' misconceptions of mathematics. Particular emphasis on meeting interdisciplinary concerns, use of technology, uses and modifications of resource materials, and current trends.

C I 590. Special Topics. Cr. 1 to 3. *Prereq: 9 graduate credits in education.*

- A. Curriculum
- B. Instructional Technology
- C. Science Education
- D. Secondary Education
- E. Environmental Education
- F. Multicultural Education
- G. Mathematics Education
- H. Gifted and Talented
- I. Elementary Education
- J. Foreign Language
- K. Educational Psychology
- L. Social Studies

C I 591. Supervised Field Experience. (0-2 to 12) Cr. 1 to 6. F.S.SS. *Prereq: 15 graduate credits in special area.* Supervised on-the-job field experience in special area. Field trip fee.

- A. Gifted and Talented - Elementary
- B. Foreign Language
- C. Elementary Education
- D. Secondary Education
- E. Gifted and Talented - Secondary

C I 593. Workshops. Cr. 1 to 3. *Prereq: 9 graduate credits in education.*

- A. Curriculum
- B. Instructional Technology
- C. Science Education
- D. Secondary Education
- E. Environmental Education
- F. Multicultural Education
- G. Mathematics Education
- H. Gifted
- I. Elementary Education
- J. Foreign Language
- K. Educational Psychology
- L. Social Studies

C I 594. Contemporary Curriculum Theory and Principles. (3-0) Cr. 3. *Prereq: Graduate standing.* Theoretical and historical perspectives of contemporary curriculum; social, cultural, and epistemological aspects of curriculum theory; political, racial, feminist, reconceptualist and postmodernist critiques of curriculum and schooling in the U.S.

C I 596. Curriculum Problems and Inquiry. (3-0) Cr. 3. *Prereq: 594.* Analysis of contemporary problems of schooling and curriculum; use of qualitative inquiry to study diverse school sites and social problems influencing public education.

C I 599. Creative Component. Cr. 1 to 3. *Prereq: 9 graduate credits in education.*

- A. Curriculum
- B. Instructional Technology
- C. Science Education
- D. Secondary Education
- E. Environmental Education
- F. Multicultural Education
- G. Mathematics Education
- H. Gifted and Talented
- I. Elementary Education
- J. Foreign Language
- K. Educational Psychology
- L. Social Studies

Courses for Graduate Students

C I 603. Advanced Instructional Systems Design. (3-0) Cr. 3. S. *Prereq: 503.* Exploration of aspects of the instructional design process, including reflective practice, recursion and iteration, participatory design, and both qualitative and quantitative formative evaluation.

C I 610. Technology in Teacher Education. (2-0) Cr. 2 or 3. Alt. S., offered 2000. *Prereq: 510, 558; admission to Ph.D. program.* Research on using technology in teacher education programs. Application examples studied. Field component involving relating material from class to a teacher education situation.

C I 611. Philosophical Foundations of Instructional Technology. (3-0) Cr. 3. *Prereq: 12 graduate credits in curriculum and instruction.* Exploration of philosophies of science that serve as foundations for research and practice in instructional technology, including positivism, post-positivism, interpretivism/constructivism, and critical theory. The roles of language, nature of truth and reality, and acceptable ways of knowing are explored in terms of their implications for instructional technology design, delivery, research, and scholarship.

C I 612. Socio-psychological Foundations of Educational Technology. (3-0) Cr. 3. *Prereq: 12 graduate credits in curriculum and instruction.* Exploration of theories of learning and associated instructional models that are the foundation for research and practice in education and educational technology, including behaviorism, information processing theory, and cognitive science. Emphasis on cognitive and social constructivist paradigms and the creation and use of constructivist learning environments supported by technology.

C I 615. Seminar. (0-2) Cr. 1. F.S.SS. Selected topics in curriculum and instruction; an analysis of research potential; evaluation of impact upon the profession; implications for additional research.

- A. Curriculum
- B. Instructional Technology
- C. Science Education
- D. Secondary Education
- E. Environmental Education
- F. Multicultural Education
- G. Mathematics Education
- H. Gifted and Talented
- I. Elementary Education
- J. Foreign Language
- K. Educational Psychology
- L. Social Studies

C I 663. Analysis of Teaching. (2-0) Cr. 2. *Prereq: 6 graduate credits in education.* Critical examination of various systems for studying and evaluating teaching; descriptive studies and conceptual systems of teaching; their nature and possible uses; major research attempts to assess teaching effectiveness along with ensuing problems connected with such efforts.

C I 690. Advanced Special Topics. Cr. arr. *Prereq: 9 graduate credits in education.*

- A. Curriculum
- B. Instructional Technology
- C. Science Education
- D. Secondary Education
- E. Environmental Education
- F. Multicultural Education
- G. Mathematics Education
- H. Gifted and Talented
- I. Elementary Education
- J. Foreign Language

K. Educational Psychology
L. Social Studies

C I 699. Research. Cr. arr. *Prereq: 9 graduate credits in education.*

- A. Curriculum
- B. Instructional Technology
- C. Science Education
- D. Secondary Education
- E. Environmental Education
- F. Multicultural Education
- G. Mathematics Education
- H. Gifted and Talented
- I. Elementary Education
- J. Foreign Language
- K. Educational Psychology
- L. Social Studies

Special Education (Sp Ed)

Courses Primarily for Undergraduate Students

Sp Ed 250. Education of the Exceptional Learner in a Diverse Society. (Same as C I 250.) (3-0) Cr. 3. F.S. *Prereq: C I 204.* An overview of students with diverse learning needs. Emphasis on early identification, educational services and strategies in inclusive settings, and preparation for community living in a diverse society.

Sp Ed 330. Introduction to Multicategorical Instruction. (3-0) Cr. 3. F. *Prereq: 250, concurrent enrollment in C I 280I.* Educational services and programming for students with mild disabilities examined from a historical perspective. Current trends, issues, programming alternatives, impact of federal and state laws, and practical approaches. Characteristics of students with mild disabilities (learning disabilities, behavioral disorders, mental disabilities).

Sp Ed 355. Classroom Assessment of Diverse Learners in the Primary Grades. (2-0) Cr. 2. S. *Prereq: Concurrent enrollment in 455; C I 433, 438, 439, 468G, 468I.* Examination and application of strategies for determining special educational needs, planning and evaluating instructional programs, and monitoring student progress.

Sp Ed 365. Classroom Assessment for Special Education. (4-0) Cr. 4. F.S. *Prereq: 330.* Formal and informal diagnostic instruments. Determination of special education needs. Planning, adaptation, and evaluation of instructional programs for students with mild disabilities.

Sp Ed 368. Issues in Literacy for Diverse Learners in the Primary Grades. (1-0) Cr. 1. F. *Prereq: Concurrent enrollment in C I 367, 468F.* Study and critical review of issues related to providing literacy instruction that meets the needs of diverse learners in inclusive primary settings.

Sp Ed 415. Supervised Student Teaching. Cr. var. F.S. *Prereq: Full admission to teacher education, senior classification, 355, 455.* Reservation required. Student teaching experience in inclusive primary grade classrooms.

Sp Ed 416. Supervised Student Teaching. Cr. var. F.S. *Prereq: Full admission to teacher education, senior classification, student in elementary education section, 330, 365, 436, 439, 457; C I 280, 478.* Reservation required.

Sp Ed 436. Methods of Multicategorical Instruction. (3-0) Cr. 3. S. *Prereq: 245, concurrent enrollment in 365, 459.* Instructional strategies/techniques in academic areas and materials for individual instruction and classroom management for elementary students with mild disabilities.

Sp Ed 439. Transition Life Span Programming for Students with Mild Disabilities. (3-0) Cr. 3. F. *Prereq: 330.* Study of curriculum and transition issues for students with mild disabilities.

Sp Ed 455. Instructional Methods for Diverse Learners in the Primary Grades. (2-0) Cr. 2. S. *Prereq: Concurrent enrollment in 355; C I 433, 438, 439, 468G, 468I.* Instructional strategies and techniques in academic areas that support the learning of students with diverse learning needs. Emphasis on accommodations, modifications, and alternative teaching strategies to meet individual student needs.

(Interdepartmental Program)

Mark Chidister, Program Coordinator

The Design Studies program brings together courses that deal with the integrated study of the conceptualization, production, visible form, uses, and history of artifacts, buildings, and environments as well as the common qualities and connections among the design fields. Students in any college may elect to take a minor in Design Studies.

Minor

The undergraduate minor in Design Studies is constructed to facilitate design awareness among interested students and to provide a vehicle for interdisciplinary study within the College of Design.

Students seeking a Design Studies minor complete fifteen credits including three credits of history selected from College of Design course offerings and twelve additional credits selected from College of Design course offerings. Courses from Architecture, Art and Design, Community and Regional Planning, Landscape Architecture, and Design Studies may be taken to meet the requirements of the minor.

At least six of the fifteen credits must be taken at Iowa State University in courses numbered 300 or above. At least nine of the fifteen credits must not be used to meet any other college or university requirements except the credit requirement for graduation.

Students enrolled in the College of Design may not use courses in their major to satisfy this minor.

Additional information is available in the Student Programs and Services Office, 297 College of Design.

Graduate Study

Courses open for nonmajor graduate credit: 380, 381, 382, 383, 385, 386, 387, 389, 394, 395, 396, 471.

Courses Primarily for Undergraduate Students

Dsn S 129. Introduction to Creativity. (Same as L A 129.) (3-0) Cr. 3. F. Creativity and humor in the problem solving process. The use of lateral thinking for developing new ideas. Materials fee, field trip fee.

Dsn S 181. History of Design. (Same as Art H 181.) (3-0) Cr. 3. F.S. Study of issues and artifacts, their relation to the traditional and changing role of the creators, and to western culture.

Dsn S 221. History of Western Architecture I. (Same as Arch 221.) See *Architecture*.

Dsn S 222. History of Western Architecture II. (Same as Arch 222.) See *Architecture*.

Dsn S 270. Forces Shaping Our Metropolitan Environment. (Same as C R P 270.) See *Community and Regional Planning*.

Dsn S 273. Landscape Architectural History: pre-history to 1900. (Same as L A 273.) See *Landscape Architecture*.

Dsn S 280. History of Art I. (Same as Art H 280.) See *Art History*.

Dsn S 281. History of Art II. (Same as Art H 281.) See *Art History*.

Sp Ed 457. Teaching Exceptional Learners in the Regular Classroom. (Same as C I 457.) (3-0) Cr. 3. F.S. Prereq: 250. Emphasis on teaching techniques, teacher attitudes, and instructional modifications for mainstreaming exceptional learners. Nonmajor graduate credit.

Sp Ed 459. Field Experience and Practicum-Students with Mild Disabilities. (0-2) Cr. 1. Prereq: Concurrent enrollment in 365, 436. Observation and involvement with students with mild disabilities in a multicategorical classroom setting. Offered on a satisfactory-fail grading basis only.

Sp Ed 490. Independent Study. Cr. 1 to 5. Prereq: 12 credits in elementary education, permission of department head.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Sp Ed 503. Introduction to Behavior Disorders. (1-0) Cr. 1. Prereq: Teaching license; taken concurrently with 504 and 505. Characteristics, identification procedures and patterns of service delivery, and exemplary education programs, and concerns about management of students with behavior disorders.

Sp Ed 504. Introduction to Learning Disabilities. (1-0) Cr. 1. Prereq: Teaching license; taken concurrently with 503 and 505. Conceptualizations of characteristics of learning disabilities, as well as etiologies of learning problems.

Sp Ed 505. Introduction to Multicategorical Instruction. (1-0) Cr. 1. Prereq: Teaching license; taken concurrently with 503, 504. Historical development of educational services; current trends and issues, basic theoretical and practical approaches with educational alternatives; implications of state and federal statutes.

Sp Ed 512. Educational Interventions for Children and Youth with Behavior Disorders. (2-0) Cr. 2. Prereq: Teaching license; concurrent enrollment in 513 or 514. Intervention approaches to meet the academic, social, and emotional needs of children and youth with behavior disorders in the school setting. Adapting educational materials and plans; coordination of school and community.

Sp Ed 513. Educational Interventions for Children with Behavior Disorders in the Elementary Schools. (1-0) Cr. 1. Prereq: Teaching license, concurrent enrollment in 512. Application of the basic principles of educational intervention approaches to elementary school children who are identified as behaviorally disordered.

Sp Ed 514. Educational Interventions for Youth with Behavior Disorders in the Secondary Schools. (1-0) Cr. 1. Prereq: Teaching license, concurrent enrollment in 512. Application of the basic principles of educational intervention approaches to secondary school youth who are identified as behaviorally disordered.

Sp Ed 515. Curriculum Based Assessment of Children and Youth with Learning and Behavioral Disorders. (3-0) Cr. 3. Prereq: Teaching license. Individual educational diagnostic procedures and techniques.

Sp Ed 517. Seminar: Research in Educational Interventions and Management of Children and Youth with Disabilities. (2-0) Cr. 2. Prereq: 512 or 531 or 541, 515. Critical review of recent literature in education and psychobehavioral sciences as applied to education of students with mild to severe disabilities.

Sp Ed 531. Methods for Teaching Multicategorical Classrooms. (2-0) Cr. 2. Prereq: 505; concurrent enrollment in 532 or 533. Remedial instructional models and materials for individualized instruction and behavior management for students with mild disabilities.

Sp Ed 532. Multicategorical Strategies for Elementary Teaching. (1-0) Cr. 1. Prereq: Concurrent enrollment in 531. Application of teaching/learning strategies appropriate at the elementary level.

Sp Ed 533. Multicategorical Strategies for Secondary Teaching. (1-0) Cr. 1. Prereq: Concurrent enrollment in 531. Application of teaching/learning strategies appropriate at the secondary level.

Sp Ed 541. Teaching Strategies for Learning Disabilities. (2-0) Cr. 2. Alt. F., offered 2000. Prereq: 504, concurrent enrollment in 542 or 543. Analysis instructional of techniques and materials for remedying specific learning disabilities.

Sp Ed 542. Learning Disabilities Strategies for Elementary Teaching. (1-0) Cr. 1. Alt. F., offered 2000. Prereq: Concurrent enrollment in 541. Application of instructional strategies and materials modification for elementary school students.

Sp Ed 543. Learning Disabilities Strategies for Secondary Teaching. (1-0) Cr. 1. Alt. F., offered 2000. Prereq: Concurrent enrollment in 541. Application of instructional strategies and materials modification for secondary school students.

Sp Ed 553. Reading for Adolescents with Mild Disabilities. (Same as C I 553.) (3-0) Cr. 3. S. Prereq: Teaching license. Instructional strategies for enhancing the comprehension and retention of students with mild disabilities, in conjunction with content-area reading material.

Sp Ed 555. Career Education and Transition for Youth with Learning and Behavior Disabilities. (2-0) Cr. 2. Prereq: Teaching license. Examination of the academic, personal, social, employability, and daily living skills needed for a satisfactory adult life. Exploration of curricula, programs, and services to meet these needs.

Sp Ed 560. Classroom Management. (3-0) Cr. 3. Prereq: Teaching license. Current classroom management techniques. Emphasis on practical use of techniques with students in regular and special education classrooms.

Sp Ed 564. Consultation/Collaboration Methods in Special Education. (2-0) Cr. 2. Prereq: Teaching license. Techniques for collaboratively solving classroom problems by professionals with diverse expertise and responsibilities.

Sp Ed 565. Role of the Consultant. (1-0) Cr. 1. Prereq: 564. Explore role of the educational consultant in different settings (state department, area education agency, school district, private). Examine roles in relationship to models (mental health, collaborative, organization).

Sp Ed 567. Principles of Corrective Mathematics for Secondary Teachers. (Same as C I 567.) See *Curriculum and Instruction*.

Sp Ed 590. Special Topics. Cr. 1 to 5. Prereq: 15 credits in education, permission of department head.

Sp Ed 591. Supervised Field Experience. (0-2 to 12) Cr. 1 to 6. F.S.SS. Prereq: 15 graduate credits in special area, admission to the graduate program in special education. Supervised on-the-job field experience in special areas. Field trip fee.

- A. Learning Disabilities, Elementary.
- B. Learning Disabilities, Secondary.
- C. Behavioral Disorders—Mild, Elementary.
- D. Behavioral Disorders—Mild, Secondary.
- E. Behavioral Disorders—Moderate to Severe, Elementary.
- F. Behavioral Disorders—Moderate to Severe, Secondary.
- G. Multicategorical, Elementary.
- H. Multicategorical, Secondary.
- I. Multicategorical SCI-Elementary
- J. Multicategorical SCI-Secondary

Sp Ed 593. Workshop. Cr. 1 to 5. Prereq: 15 credits in education.

Sp Ed 599. Creative Component. Cr. 1 to 5. Prereq: 15 credits in education.

Courses for Graduate Students

Sp Ed 615. Seminar. (0-2) Cr. 1. Prereq: 15 credits in education. Selected topics in special education; presentation, discussion, and analysis of published research and student or faculty research projects.

Sp Ed 699. Research. Cr. arr. Prereq: 15 credits in education.

Dsn S 292. Dimensions of Art and Design. (Same as Art 292.) See *Art and Design*.

Dsn S 293. Environmental Planning. (Same as C R P 293.) See *Community and Regional Planning*.

Dsn S 315. Housing. (Dual-listed with 515; same as C R P 315.) See *Community and Regional Planning*.

Dsn S 317. Urban Revitalization. (Dual-listed with 517; same as C R P 317.) See *Community and Regional Planning*.

Dsn S 325. Growth Management. (Dual-listed with 525; same as C R P 325.) See *Community and Regional Planning*.

Dsn S 329. Planning in Developing Countries. (Dual-listed with 529; same as C R P 329.) See *Community and Regional Planning*.

Dsn S 342. Site Analysis and Development Design. (Dual-listed with 542; same as C R P 342.) See *Community and Regional Planning*.

Dsn S 351. Solar Home Design. (Same as Arch 351.) See *Architecture*.

Dsn S 365. Technology and the City. (Dual-listed with 565; same as C R P 365.) See *Community and Regional Planning*.

Dsn S 371. Landscape Architectural History: 1900 to present. (Same as L A 371.) See *Landscape Architecture*.

Dsn S 376. Environmental Art. (Dual-listed with 576; same as L A 376.) See *Landscape Architecture*.

Dsn S 380. North American Indian Art. (Dual-listed with 580; same as Art H 380.) See *Art History*.

Dsn S 381. Art and Architecture of India. (Dual-listed with 581; same as Art H 381.) See *Art History*.

Dsn S 382. Art and Architecture of Asia. (Dual-listed with 582; same as Art H 382.) See *Art History*.

Dsn S 383. Greek and Roman Art. (Dual-listed with 583; same as Art H 383.) See *Art History*.

Dsn S 385. Renaissance Art. (Dual-listed with 585; same as Art H 385.) See *Art History*.

Dsn S 386. Baroque and Rococo Art. (Dual-listed with 586; same as Art H 386.) See *Art History*.

Dsn S 387. Nineteenth Century Art. (Dual-listed with 587; same as Art H 387.) See *Art History*.

Dsn S 388. Modernism and Modern Art: 1880-1945. (Dual-listed with 588; same as Art H 388.) See *Art History*.

Dsn S 389. European and American Art: 1945-1970. (Dual-listed with 589; same as Art H 389.) See *Art History*.

Dsn S 394. Women in Art. (Dual-listed with 594; same as Art H 394.) See *Art History*.

Dsn S 395. Contemporary Art and Theory Since 1970. (Dual-listed with 595; same as Art H 395.) See *Art History*.

Dsn S 396. History of Photography. (Dual-listed with 596; same as Art H 396.) See *Art History*.

Dsn S 398. Selected Topics in Art History. (Dual-listed with 598; same as Art H 398.) See *Art History*.

Dsn S 446. Interdisciplinary Design Studio. (Dual listed with 546.) (0-12 to 0-18) Cr. 4 to 6. F.S. Prereq: *Junior classification in a c curriculum in the College of Design and permission of instructor.* Advanced interdisciplinary design projects. Field trip fee, materials fee.

Dsn S 463. Housing Environments for Elderly and Disabled Persons. (Same as HD FS 463.) See *Human Development and Family Studies*.

Dsn S 467. Preservation, Restoration, and Rehabilitation. (Same as Arch 467.) See *Architecture*.

Dsn S 471. Design for All People. (Same as Arch 471.) See *Architecture*.

Dsn S 484. Sustainable Communities. (Dual-listed with 584; same as C R P 484.) See *Community and Regional Planning*.

Dsn S 491. Environmental Law. (Dual-listed with 591; same as C R P 491.) See *Community and Regional Planning*.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Dsn S 515. Housing. (Dual-listed with 315; same as C R P 515.) See *Community and Regional Planning*.

Dsn S 517. Urban Revitalization. (Dual-listed with 317; same as C R P 517.) See *Community and Regional Planning*.

Dsn S 525. Growth Management. (Dual-listed with 325; same as C R P 525.) See *Community and Regional Planning*.

Dsn S 528. Topical Studies in History, Theory, and Criticism of Architecture. (Same as Arch 528.) See *Architecture*.

Dsn S 529. Planning in Developing Countries. (Dual-listed with 329; same as C R P 529.) See *Community and Regional Planning*.

Dsn S 542. Site Analysis and Development Design. (Dual-listed with 342; same as C R P 542.) See *Community and Regional Planning*.

Dsn S 546. Interdisciplinary Design Studio. (Dual-listed with 446.) (0-15) Cr. 4 to 6 each time taken, maximum of 12. F.S.SS. Prereq: *Admission to a graduate program in the College of Design and permission of instructor.* Advanced interdisciplinary design projects. Field trip fee, materials fee.

Dsn S 558. Appropriate Technologies for Architecture. (Same as Arch 558.) See *Architecture*.

Dsn S 562. Housing Design Issues. (Same as Arch 562.) See *Architecture*.

Dsn S 565. Technology and the City. (Dual-listed with 365; same as C R P 565.) See *Community and Regional Planning*.

Dsn S 566. Housing for Specific Groups. (Same as Arch 566.) See *Architecture*.

Dsn S 573. Post-Occupancy Evaluation. (Same as Arch 573.) See *Architecture*.

Dsn S 575. Contemporary Urban Design Theory. (Same as Arch 575.) See *Architecture*.

Dsn S 577. Social Impact of the Built Environment. (Same as Arch 577.) See *Architecture*.

Dsn S 576. Environmental Art. (Dual-listed with 376; same as L A 576.) See *Landscape Architecture*.

Dsn S 580. North American Indian Art. (Dual-listed with 380; same as Art H 580.) See *Art History*.

Dsn S 581. Art and Architecture of India. (Dual-listed with 381; same as Art H 581.) See *Art History*.

Dsn S 582. Art and Architecture of Asia. (Dual-listed with 382; same as Art H 582.) See *Art History*.

Dsn S 583. Greek and Roman Art. (Dual-listed with 383; same as Art H 583.) See *Art History*.

Dsn S 584. Sustainable Communities. (Dual-listed with 484; same as C R P 584.) See *Community and Regional Planning*.

Dsn S 585. Renaissance Art. (Dual-listed with 385; same as Art H 586.) See *Art History*.

Dsn S 586. Baroque and Rococo Art. (Dual-listed with 386; same as Art H 586.) See *Art History*.

Dsn S 587. Nineteenth Century Art. (Dual-listed with 387; same as Art H 587.) See *Art History*.

Dsn S 588. Modernism and Modern Art: 1880-1945. (Dual-listed with 388; same as Art H 588.) See *Art History*.

Dsn S 589. European and American Art: 1945-1970. (Dual-listed with 389; same as Art H 589.) See *Art History*.

Dsn S 591. Environmental Law. (Dual-listed with 491; same as C R P 591.) See *Community and Regional Planning*.

Dsn S 594. Women in Art. (Dual-listed with 394; same as Art H 594.) See *Art History*.

Dsn S 595. Contemporary Art and Theory Since 1970. (Dual-listed with 395; same as Art H 595.) See *Art History*.

Dsn S 596. History of Photography. (Dual-listed with 396; same as Art H 596.) See *Art History*.

Dsn S 598. Selected Topics in Art History. (Dual-listed with 398; same as Art H 598.) See *Art History*.

Ecology and Evolutionary Biology

(Interdepartmental Graduate Major)

Supervisory Committee: W. R. Clark, Chair; B.J. Danielson, J. H. Dekker, T.C. Harrington, E. R. Hart, M. S. Kaiser, K. A. Moloney, R. C. Schultz, C. M. Vleck

The ecology and evolutionary biology interdepartmental major is offered through a faculty housed in eight departments of the university. Faculty from the departments of Agronomy, Animal Ecology, Botany, Entomology, Forestry, Plant Pathology, Statistics, and Zoology and Genetics cooperate to offer courses and research opportunities leading to the M.S. and Ph.D. degrees with a major in ecology and evolutionary biology.

Applicants should have completed an undergraduate or master of science or arts degree in one of the biological, physical, or mathematical sciences or should have equivalent preparation. Students with degrees in the physical or mathematical sciences should have taken undergraduate courses in both basic ecology and evolution.

Students majoring in ecology and evolutionary biology may prepare themselves for careers focused on basic or applied ecology and evolutionary biology in a variety of settings, including academia, government, industry, and private organizations. For example, graduates often work in wetland restoration and management, conservation of biodiversity and ecological systems, natural resource and wildlife management, environmental analysis and management, forestry, and agriculture. Graduates have a broad understanding of ecology and evolutionary biology, have had experiences designing and conducting research, writing grant proposals, and communicating effectively with scientific colleagues at meetings and by writing publications.

The ecology and evolutionary biology major is designed for students interested in the study of mechanisms controlling the composition, structure, and functional processes of ecological systems and the mechanisms that regulate the pattern and rate of evolutionary change within and among species. Cooperating departments offer courses in physiological, population, community, ecosystem, and landscape ecology; aquatic and wetland ecology; forest ecology; agroecology; animal behavior; wildlife and resource management; systematics; genetics; and evolution. In addition, interdisciplinary ecology and evolutionary courses are offered, including a special topics course, a seminar, and an extended field trip.

Information on application procedures, research interests of the faculty, and specific requirements of the major can be obtained from the chair of the supervisory committee.

Courses for Graduate Students

EEB 585. Extended Field Trip (0-6) Cr. 2 each time taken. F.S. Prereq: Graduate classification. Annual field trip to a region of North America to study the major terrestrial and aquatic ecosystem types of the region. Report required. Field trip fee.

EEB 590. Special Topics. Cr. 1 to 3 each time taken. Prereq: Graduate classification and permission of instructor.

EEB 698. Seminar. (1-0) Cr. 1 each time taken. F.S. Reports and discussion of recent research and literature.

EEB 699. Research.

Economics

www.econ.iastate.edu

John A. Miranowski, Chair of Department

Distinguished Professors: Allen, Baumel, Fuller, Harl, Johnson, Sandler

University Professors: Enders, Lapan, Wisner

Professors: J. Adams, R. Adams, Babcock, Choi, Deiter, Duffy, Edelman, Edwards, Fletcher, Ginder, Hallam, Hayenga, Hayes, Huffman, Jensen, Jolly, Kliebenstein, Kling, Mattila, Meyers, Miranowski, Moschini, Orazem, Otto, Stone, Tesfatsion, Van de Wetering

Distinguished Professors (Emeritus): Fox, Ladd, Luckett, Timmons

Professors (Collaborators): Hansen

Professors (Emeritus): Beneke, Howell, Julius, Kolmer, Merrill, Meyer, Paulsen, Prescott, Scott, Skadberg, Starleaf, Stephenson, Stoneberg

Associate Professors: Antonovitz, Beghin, Falk, Gallagher, Herriges, Lawrence, Lence, Quirmbach, Schroeter

Associate Professors (Adjunct): Alexander

Associate Professors (Emeritus): Doak, Pounds

Assistant Professors: Biliias, Bose, Hennessy, Hueth, Kilkenny, Lewin, Miller, Morelli, Reed, Vesterlund, Zhao

Assistant Professors (Adjunct): Luvaga

Undergraduate Study

The department offers work for the degree bachelor of science with a major in agricultural business, and for the degree bachelor of science with a major in economics. For further discussion of programs in agricultural business, see the statement under *College of Agriculture*. For programs in economics, see the statement under *College of Liberal Arts and Sciences*. Visit our web site at www.econ.iastate.edu

Graduates of the Department of Economics have unique skills that distinguish them from other graduates. They have the ability to think and reason clearly, and can address complex issues using tools and decision making mod-

els of economics, mathematics, statistics, as well as concepts from the biological, physical, and social sciences. Graduates develop human relations skills that are essential in the work place and the community. They are able to communicate economic and business concepts to other professionals, collective organizations, governments, and the general public using a variety of means. Graduates understand the interaction of technology, human activity, and the environment. They are able to apply concepts associated with making "optimal" choices among economic alternatives. Graduates are prepared for graduate work in law, economics, and business, as well as the world of work, having learned tools of critical analysis and skills essential to getting and keeping meaningful employment.

College of Agriculture

For the undergraduate curriculum in agricultural business, see *College of Agriculture, Curricula*.

The agricultural business curriculum prepares students for advanced studies and for careers in agricultural finance, management in agricultural supply and marketing industries, commodity analysis and research, business research and management, farm and ranch operations, commercial farm management and appraisal, agricultural sales and marketing, agricultural reporting and public relations, agricultural extension, and government service. A major in agricultural business with a minor in economics is not permitted.

College of Liberal Arts and Sciences

Candidates for the bachelor of science degree with a major in economics must fulfill requirements established by the College of Liberal Arts and Sciences. (For details of undergraduate curricula in liberal arts and sciences, see *College of Liberal Arts and Sciences, Curriculum*.)

The economics curriculum prepares students for advanced studies, professional degrees such as law and business administration, and for careers in finance, business and economic research, management, sales and marketing, insurance, brokerage, real estate, labor relations, international development, and government service.

Students majoring in economics are required to take Math 150, 151, and 252 within the mathematical and natural sciences group. Students who plan to take postgraduate work in economics, or who want a more quantitative program should substitute Math 165, 166, and 265 for the above sequence. Additional requirements are Statistics 227 and Computer Science 103. Twenty-eight credits in economics are required for the bachelor of science degree. These 28 must include Econ 101, 102, 301, 302, 472, and 492. In addition, two courses are required from advanced undergraduate courses in the department. Advanced courses are defined as having either 301 or 302 (or both) as a prerequisite. Economics majors must maintain a C average in 101, 102, 301, and 302, with no grade lower than a C-.

Typical progress for an economics major would be to complete the principles sequence, 101 and 102, in the freshman year.

Math 150 and 151 (or the Math 165, 166 sequence) should also be completed in the freshman year, followed by the intermediate theory sequence, Econ 301 and 302, in the sophomore year. Math 252 (or 265) should be completed in the sophomore year. Computer Science 103 and Statistics 227 are recommended in the sophomore year. Required advanced courses and electives should be taken in the junior and senior years.

A minor in economics is offered. Courses to be included in the minimum of 15 hours are Econ 101, 102, 301, and 302.

English Proficiency Requirement: The major in economics requires a grade of C or better in each of the following English courses: 104, 105 (or 105H), and 314.

The department participates in the interdepartmental programs in international studies and women's studies.

Graduate Study

The department offers the degrees master of science and doctor of philosophy with majors in economics and agricultural economics. The department also offers minors to students with majors in other departments.

Students do not need to have an undergraduate major in economics or agricultural economics in order to qualify for graduate work in the department. However, students must have completed undergraduate coursework in macroeconomics, microeconomics, statistics, and calculus. Background in matrix algebra is preferred, particularly for the Ph.D.

Candidates for the degree master of science (thesis option) are required to complete satisfactorily 30 credits of acceptable graduate work, including preparation of a thesis.

Candidates for the degree master of science (non-thesis option) may fulfill requirements by satisfactorily completing 32 credits of coursework, including preparation of a creative component.

Programs of study for the doctorate are organized by each student in consultation with the major professor and the individual's committee. Students may select fields of concentration from the following: agricultural economics, econometrics, economic growth and development, financial economics, industrial organization, international economics, labor economics, macroeconomics, natural resource and environmental economics, and public economics.

Each student must complete advanced courses in microeconomic and macroeconomic theory, statistics and econometrics, and two fields from the list above. Students must demonstrate competence in theory by passing qualifying examinations. Examinations are also required in the two field areas. Students must also participate in workshops.

With the cooperation of the College of Law at Drake University, a joint degree consisting of doctor of jurisprudence and master of science in agricultural economics or economics may be pursued concurrently. Other cooperative programs of study may be arranged with the

University of Iowa College of Law or other recognized institutions.

The department cooperates in the interdepartmental programs in business administrative sciences and industrial relations, the interdepartmental major in transportation, and interdepartmental minors in gerontology and housing.

Courses open for nonmajor graduate credit: 301, 302, 320, 321, 322, 332, 335, 344, 355, 376, 385, 401, 402, 415, 430, 432, 437, 441, 451, 452, 455, 460, 466, 470, 472, 480.

Courses Primarily for Undergraduate Students

Econ 101. Principles of Microeconomics. (3-0) Cr. 3. F.S.SS. Resource allocation, opportunity cost, comparative and absolute advantage. Supply and demand. Marginal analysis. Theories of production and consumption, pricing, and the market system. Perfect and imperfect competition and strategic behavior. Factor markets. Present discounted value.

Econ 101H. Principles of Microeconomics. (3-0) Cr. 3. F. Resource allocation, opportunity cost, comparative and absolute advantage. Supply and demand. Marginal analysis. Theories of production and consumption, pricing, and the market system. Perfect and imperfect competition and strategic behavior. Factor markets. Present discounted value. Open only to honors students.

Econ 101L. Laboratory in Principles of Microeconomics. (0-2) Cr. 1. F. *Prereq: Concurrent enrollment in the appropriate section of 101.* Discussion of material typically covered in Econ 101. Application of economic principles to real world problems. Economic principles and basic business management concepts applied to decision-making in agribusiness operations. Guest class visits by academic, government and industry representatives. Field trips to agribusiness firms. Field trip fee.

Econ 102. Principles of Macroeconomics. (3-0) Cr. 3. F.S.SS. *Prereq: 101 recommended.* Measurement of macro variables and general macro identities. Classical models of full employment. Production and growth. Savings and investment. Employment and unemployment. Money, inflation, and price levels. Operation of the U.S. banking system. Fiscal and monetary policy. Elements of international finance.

Econ 102H. Principles of Macroeconomics. (3-0) Cr. 3. S. *Prereq: 101 or 101H.* Measurement of macro variables and general macro identities. Classical models of full employment. Production and growth. Savings and investment. Employment and unemployment. Money, inflation, and price levels. Operation of the U.S. banking system. Fiscal and monetary policy. Elements of international finance. Open only to honors students.

Econ 110. Orientation in Economics/Agricultural Business. (1-0) Cr. R. F. Orientation course for freshman and new transfer students in agricultural business and economics.

Econ 135. Agricultural Firms, Markets and Prices. (3-0) Cr. 3. F.S. *Prereq: 101.* Basic concepts and economics principles related to markets for agricultural inputs and products. Overview of marketing problems faced by farms and agribusinesses, farm and retail price behavior, structure of markets, and the role of agriculture in the general economy and international trade. Introduction to hedging, futures, and other risk management tools. Field trip and materials fee.

Econ 292. Career Seminar. (1-0) Cr. 1. F. *Prereq: Classification in economics or agricultural business.* Career opportunities in the various industries and government institutions with an emphasis on agribusiness. Required training and skills needed to perform successfully in different types of careers. Factors important in finding and obtaining employment either before or after graduation including personal resumes, interviewing, and letter writing. Offered on a satisfactory-fail grading basis only.

Econ 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Econ 301. Intermediate Microeconomics. (3-0) Cr. 3 or (3-1) Cr. 4. F.S.SS. *Prereq: 101; Math 151 or 165.* Theory of consumer and business behavior: optimal consumption choices and demand; theory of firm behavior: costs, production, and supply; competitive and imperfectly competitive markets; theory of demand for and supply of factors of production; general equilibrium analysis. Nonmajor graduate credit.

Econ 302. Intermediate Macroeconomics. (3-0) Cr. 3. F.S.SS. *Prereq: 101, 102; Math 151 or 165.* Theory of income, employment, interest rates, and the price level; fiscal and monetary policy; budget and trade deficits; money and capital inflows, interest rates, and inflation. Nonmajor graduate credit.

Econ 312. History of Economic Thought. (3-0) Cr. 3. S. *Prereq: 101.* The logic and explanatory value of received economic doctrines since the middle of the eighteenth century. The reflection of past economic doctrines in contemporary theory and policy. Discussion of major works by Smith, Ricardo, Mill, Marx, Marshall, Walras, Wicksell, and Keynes.

Econ 320. Labor Economics. (3-0) Cr. 3. F. *Prereq: 101.* Survey of contemporary labor market problems and public policy toward labor. Economic analysis of topics such as labor supply and hours of work, work incentives of transfer programs, education and training, mobility, labor demand and employment, minimum wages, unions, income distribution and relative wages, discrimination, unemployment and wage inflation. Nonmajor graduate credit.

Econ 321. Economics of Discrimination. (Same as W S 321.) (3-0) Cr. 3. F. *Prereq: 101.* Economic theories of discrimination. Analysis of the economic problems of women and minorities in such areas as earnings, occupations, and unemployment. Public policy concerning discrimination. Nonmajor graduate credit.

Econ 322. Collective Bargaining. (3-0) Cr. 3. S. *Prereq: 320.* Economic analysis and institutional aspects of unions and collective bargaining. Organizing, bargaining strategy, and contract terms; impact of unions on employment and wages. Public policy toward unions, strikes, and negotiated benefits in both the private and public sectors. Nonmajor graduate credit.

Econ 330. Farm Business Management. (2-2) Cr. 3. F.S. *Prereq: 101; Acct 284.* Business and economic principles applied to decision making and problem solving in the management of a farm business. Cash flow, partial, enterprise, and whole farm budgeting. Information systems for farm accounting, analysis, and control. Obtaining and managing land, capital, and labor resources. Alternatives for farm business organization.

Econ 332. Cooperatives. (2-0) Cr. 2. S. *Prereq: 101.* Survey of cooperative activities with emphasis on agricultural cooperatives, types of cooperatives, methods of organization and operation, principles, legal and tax aspects, cooperative finance, economic possibilities, and limitations of cooperation. Field trip fee. Nonmajor graduate credit.

Econ 335. Agricultural Market Organization and Pricing. (2-2) Cr. 3. F.S.SS. *Prereq: 135, 301, Stat 227.* Theory of markets, price determination and market strategies in the food and agricultural sector. Structure of the firm, competition, monopoly, cooperative and non-cooperative oligopoly, and product differentiation. Equilibrium of markets over space and time. Marketing decisions under risk and uncertainty, contingent claims markets, price patterns, and price forecasting. Price discrimination, strategic pricing, and vertical coordination in agricultural industries. Nonmajor graduate credit.

Econ 336. Agricultural Selling. (3-0) Cr. 3. F. *Prereq: 101.* Principles of selling with application to agricultural businesses. Attitudes, value systems, and behavioral patterns that relate to agricultural sales. Relationship of sales to marketing, selling strategies, preparing for sales calls, making sales

presentations, handling objections, and closing sales. Analysis of the buying or purchasing process. Evaluation of agri-selling as a possible career choice. Materials fee.

Econ 338. Dairy Marketing. (2-0) Cr. 2. Alt. F., offered 2000. *Prereq: 101.* Trends in milk production and consumer demand for dairy products; industry organization and performance; federal milk marketing orders; dairy price support programs; dairy cooperatives; component pricing; promotional efforts.

Econ 344. Public Finance. (3-0) Cr. 3. S. *Prereq: 101.* The economic role of governments in market economies. Public goods, externalities, income distribution, and income maintenance programs. The effect of taxes on economic behavior, descriptions of the structure of the principal U.S. taxes, and current reform proposals. Nonmajor graduate credit.

Econ 353. Money and Banking. (3-0) Cr. 3. F.S.SS. *Prereq: 101, 102.* Theoretical and applied analysis of money, banking, and financial markets; interest rates and portfolio choice; the banking industry in transition; the money supply process; the Federal Reserve System and the conduct of monetary policy; macro implications of monetary policy; international finance.

Econ 355. International Economics. (4-0) Cr. 4. F. *Prereq: 101, 102.* Explanations of causes of international trade and the impact of trade on welfare and employment patterns. Analysis of government policies towards trade, such as tariffs, quotas, and free trade areas. Theory of balance of payments and exchange rate determination, and the role of government policies. Examination of alternative international monetary arrangements. Credit for either 355 or 455, but not both, may be applied to graduation. Nonmajor graduate credit.

Econ 370. Comparative Capitalism and Economic Transitions. (3-0) Cr. 3. F. *Prereq: 101, 102.*

Comparative organization and performance of variants of market capitalism, including alternative government interventions and patterns of economic growth and income distribution; analysis of planning, incentives, and enterprise behavior in variants of socialism; study of comparative economic transformations of socialist economies; assessment of future capitalism and social market economies; includes examination of the United States, Europe, Japan, Russia, and China.

Econ 376. Urban-Regional Economics. (3-0) Cr. 3. F. *Prereq: 101.* Theories of urban development; city typologies, trade, and commuting patterns; urban economic interdependence; social investment in metropolitan communities; regional growth and efficiency; locational determinants of firms and households; the regional economic base; resource development and economic planning in the city-region. Nonmajor graduate credit.

Econ 380. Environmental and Resource Economics. (Same as Env S 380.) (3-0) Cr. 3. F.S. *Prereq: 101.* Natural resource availability, use, conservation, and government policy, including energy issues. Environmental quality and pollution control policies.

Econ 381. International Economic History. (Same as Hist 381.) See *History*.

Econ 382. United States Economic History. (Same as Hist 382.) See *History*.

Econ 385. Economic Development. (3-0) Cr. 3. S. *Prereq: 101, 102.* Current problems of developing countries, theories of economic development, agriculture, and economic development, measurement and prediction of economic performance of developing countries, alternative policies and reforms required for satisfying basic needs of Third World countries, interrelationships between industrialized countries and the developing countries, including foreign aid. Nonmajor graduate credit.

Econ 397. Internship. Cr. 2 each time taken; maximum of 4. F. *Prereq: Permission of instructor and classification in agricultural business or economics.* Students complete a research report, based on their internship or approved work experience, that examines chosen topics in management, marketing or finance. Offered on a satisfactory-fail grading basis only.

Econ 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of the department cooperative education coordinator; junior classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Econ 401. Topics in Microeconomics. (3-0) Cr. 3. F. *Prereq:* 301, Stat 227. Advanced treatment of selected topics from one or more of the following areas: household production models, factor markets, game theory and imperfect competition, uncertainty, imperfect information, general equilibrium, intertemporal choice, asset markets, income distribution, externalities and public goods, etc. Nonmajor graduate credit.

Econ 402. Topics in Macroeconomics. (3-0) Cr. 3. S. *Prereq:* 301, 302, Stat 227; Econ 472 recommended. Advanced treatment of selected topics from one or more of the following areas: business cycle theory, growth theory, fiscal and monetary policy, coordination issues, open economy macroeconomics, and financial economics. Nonmajor graduate credit.

Econ 415. Economics of Imperfect Competition, Antitrust and Regulated Industries. (3-0) Cr. 3. S. *Prereq:* 301; Math 151 or 160 or 165. The economic and strategic analysis of monopoly and oligopoly, predatory pricing, cartels and price-fixing, entry barriers and entry deterrence, vertical integration, technological change, and bid-rigging and other anticompetitive practices. The economic foundations of antitrust policy and industry regulation. Nonmajor graduate credit.

Econ 430. Advanced Farm Business Management. (3-2) Cr. 4. F. *Prereq:* 330. Familiarity with personal computers is helpful but not required. Effective use of decision methods and computer assistance for solving farm problems. Applications of economic and management theory to analyze farm business decisions using efficiency measures to assess current resource use and direct the farm business analysis, planning, and tax process. Computers as aids in the decision process. Materials fee. Nonmajor graduate credit.

Econ 432. Agribusiness Management. (3-0) Cr. 3. F. *Prereq:* 335. An advanced topics course in agribusiness management. Students explore the economics of management, organization and strategy as applied to agricultural businesses, vertical and horizontal boundaries of the firms, market structure and competition, competitive advantage, motivation and coordination, organizational efficiency. Nonmajor graduate credit.

Econ 437. Applied Commodity Marketing and Price Analysis. (3-0) Cr. 3. S. *Prereq:* 335. Applied commodity price analysis and forecasting; futures market theory and hedging strategy evaluation; options theory and strategy evaluation. Nonmajor graduate credit.

Econ 441. Economics of Agricultural Production. (3-2) Cr. 4. *Prereq:* 301, Stat 227. Economic concepts applied to the design, evaluation, and management of agricultural production technologies. Estimation and interpretation of production functions. Use of mathematical programming and simulation models for technology assessment. Economics of technology adoption and transfer, farming systems research, and sustainability. Nonmajor graduate credit.

Econ 451. Agricultural Law. (3-2) Cr. 4. F.S. *Prereq:* Senior classification. The legal framework impinging upon decision-making by farm firms, families, and individuals, real and personal property, contracts, secured transactions, negotiable instruments, debtor-creditor relations, bankruptcy, organization of farm firms, intergeneration property transfers, trusts, insurance, liabilities, environmental law, federal and state regulatory powers. Nonmajor graduate credit.

Econ 452. Legal Issues in Agriculture. (2-0) Cr. 2. *Prereq:* 101. Designed for off-campus programs in agriculture. Offered as demand warrants. The legal framework impinging on decision-making by individuals, families, and firms in agriculture: ownership and transfer of real property; commercial law including secured transactions, sales, and negotiable instruments; bankruptcy; income tax planning and management; estate and business planning for the farm

family; civil liabilities; water law; environmental law; government regulation of agriculture. Nonmajor graduate credit.

Econ 455. International Trade and Finance. (4-0) Cr. 4. S. *Prereq:* 301. Rigorous treatment of theories of international trade and its impact on domestic and world welfare and the distribution of income. Theoretical analysis of government policies towards trade, such as quotas, tariffs and free trade areas. Theory of exchange rate and balance of payments determination and the role of government policy; study of efficiency of the foreign exchange market. Examination of alternative international monetary arrangements. Credit for either 355 or 455, but not both, may be applied toward graduation. Nonmajor graduate credit.

Econ 460. Agricultural, Food, and Trade Policy. (3-0) Cr. 3. F.S. *Prereq:* 301. Description and analysis of economic problems of U.S. agriculture. Explanation and economic analysis of government policies and programs to develop agriculture, conserve agricultural resources, address consumer food concerns, stabilize farm prices, and raise farm incomes. The influence of macropolicy, world economy, and international trade on U.S. agriculture. Nonmajor graduate credit.

Econ 466. Introduction to Agricultural Finance. (3-0) Cr. 3. S. *Prereq:* 301, Stat 227; Fin 350 and Econ 353 recommended. Financial analysis of agricultural businesses; liquidity, capital structure, and growth of agricultural firms; risk and return; capital asset pricing model; risk management strategies in agriculture; capital budgeting methods; analysis of land investments, leasing, and costs of credit; financial intermediation and major financial institutions for agriculture; credit scoring, loan pricing, and asset-liability management techniques by financial intermediaries; public policies affecting agricultural credit markets. Nonmajor graduate credit.

Econ 470. Public Choice. (Same as Pol S 470.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 101 and Pol S 251. Application of economics to political science in the study of nonmarket decision-making. Behavior of bureaucrats, elected officials, and voters. Market failure, collective action, representative democracies, direct democracies, logrolling, voter paradoxes, game theory, and terrorism. Nonmajor graduate credit.

Econ 472. Introductory Econometrics. (4-0) Cr. 4. F. *Prereq:* 301, 302, Stat 227. Introduction to the models and methods used to estimate relationships and test hypotheses pertaining to economic variables. Simple and multiple regression analysis; stochastic regressors; heteroskedasticity; autocorrelation; measurement error; simultaneous equations. Nonmajor graduate credit.

Econ 480. Intermediate Environmental and Resource Economics. (3-0) Cr. 3. S. *Prereq:* 301. Theories of natural resource utilization and allocation. Externalities, public goods, and environmental quality. Planning natural resource use and environmental quality. Methodologies for analyzing natural resource and environmental problems. Nonmajor graduate credit.

Econ 490. Independent Study. Cr. 1 to 5 each time taken. *Prereq:* Junior or senior classification, 14 credits in economics. Students in the College of Agriculture may use no more than 6 credits of Econ 490 toward the total of 128 credits required for graduation; students in the College of Liberal Arts and Sciences may count no more than 9 credits of Econ 490 toward graduation. Offered on a satisfactory-fail grading basis only.
H. Honors.

Econ 492. Graduating Senior Seminar. (1-0) Cr. R. F.S. *Prereq:* Graduating senior. Final preparations for graduation. The final stages of job searching, interviewing, letter writing, and resume preparation. Outcomes assessment information from graduating seniors including opinion surveys, instructor/advisor/course evaluations, exit interviews, student accomplishment surveys, job placement surveys, and comprehensive skills examinations. Departmental recognition of graduating seniors. Life as an alumnus - expectations and obligations.

Convocation and commencement information. Offered on a satisfactory-fail grading basis only.

Econ 493. Workshops. Cr. 1 to 3 each time taken. No more than 6 credits may be applied towards graduation. *Prereq:* Permission of instructor. Offered on a satisfactory-fail grading basis only.

Econ 496. Economics Travel Course. Cr. 1 to 3 each time taken. *Prereq:* Sophomore status; permission of instructor. Tour and study of production methods in major crop and livestock regions of the world. Influence of economics, markets, climate, culture, soils, landscapes, and geography on livestock and crop production. Locations and duration of tours will vary. Limited enrollment. Field trip fee.

Econ 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of the department cooperative education coordinator; senior classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Econ 500. Quantitative Methods in Economic Analysis I. (4-0) Cr. 4. F. *Prereq:* 301, 1 year of calculus, Stat 401 or equivalent, and permission of Director of Graduate Studies. Economic applications of selected mathematical and statistical concepts: linear models and matrix algebra; differential calculus and optimization; integral calculus and economic dynamics; probability distributions, estimation, and hypothesis testing in the analysis of economic data.

Econ 501. Microeconomics. (4-0) Cr. 4. F. *Prereq:* 301, credit or enrollment in 500 or equivalent background in calculus and statistics. The theory of the consumer, theory of the firm, perfect and imperfect competition, welfare economics, and selected topics in general equilibrium and uncertainty. This is a Master's level course.

Econ 502. Macroeconomics. (4-0) Cr. 4. F. *Prereq:* 302, credit or enrollment in 500 or equivalent background in calculus and statistics. Models of aggregate supply and demand, theories of consumption and investment, money supply and demand, inflation, rational expectations, stabilization policy, financial markets, and international finance. This is a Master's level course.

Econ 513. History of Economic Analysis. (3-0) Cr. 3. *Prereq:* 301 and 302. The ideas of great economists from the eighteenth to the twentieth centuries. Adam Smith, David Ricardo, Thomas Robert Malthus, John Stuart Mill, Karl Marx, William Stanley Jevons, Leon Walras, John Bates Clark, Thorstein Veblen, Alfred Marshall, John Maynard Keynes, and John R. Hicks.

Econ 515. Industrial Organization I. (3-0) Cr. 3. F. *Prereq:* 501 or 601. Theoretical and empirical studies of industry structure, conduct, and performance. Introduction to game theory. Monopoly, oligopoly, monopolistic competition, collusion, and cartels. Contestable markets. Entry barriers and deterrence. Concentration and performance. Price discrimination. Product differentiation and spatial markets.

Econ 520. Labor Supply and Human Capital Formation. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 501 or 601. Labor supply decisions and empirical analysis for agricultural operators and wage-earning households: multiple job holding; resource allocation in productive households; human capital formation by households, firms, and public institutions, which includes schooling, on-the-job training, migration, health, research, raising of children, and implications for household income and welfare; applications to problems in rural areas of developing and developed countries.

Econ 521. Labor Markets. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 501 or 601. Modern analysis of labor demand and market determination of wages and employment; analysis of distortions in labor markets due to non-competitive forces, legislation, and discrimination; microeconomic analysis of unemployment and job search.

Econ 530. Advanced Farm Management. (2-0) Cr. 2. *Prereq:* 6 credits in economics. Offered off campus as demand warrants. Management techniques of planning, implementation, and control as applied to farm businesses. Quantitative tools as applied to agricultural decision-making. Accounting control concepts and decision theory as used to manage agricultural enterprises. Designed for master of agriculture program only.

Econ 532. Business Economics. (3-0) Cr. 3. *Prereq:* 101 and enrollment in MBA or BAS program; not for economics majors. Applications of microeconomic theory and decision analysis. Demand analysis, production and cost analysis, forecasting, pricing, market structures and strategy, capital investment analysis, decision-making under uncertainty, government and business.

Econ 534. Mathematical Programming in Agricultural and Applied Economics. (3-0) Cr. 3. *Prereq:* 3 credits in economics at the 400 level or above. Linear programming and the Simplex method; sensitivity analysis and parametric programming; goal programming, stochastic programming, and other extensions of linear programming; input-output and interregional models; nonlinear and quadratic programming to reflect production, marketing, and financial risk; comparison with other criteria for making risky decisions; integer programming and investment analysis; use of recursive and dynamic programming in long-term planning and farm firm growth models.

Econ 535. Agricultural Marketing. (3-0) Cr. 3. F. *Prereq:* 501 or 532 or 601. Analysis of agricultural marketing systems focusing on their structure, pricing and coordination mechanisms (including futures markets), and performance. Government market intervention and regulation methods. Comparison of market mechanisms and problems in the U.S. and centrally planned or developing countries.

Econ 536. Applied Agricultural Marketing. (2-0) Cr. 2. *Prereq:* 6 credits in economics. Off campus. Offered as demand warrants. Market structure and performance in the food and agricultural sector. Vertical coordination systems and pricing systems in agriculture. Market information and price forecasting. Alternative marketing methods and strategies for major Iowa agricultural commodities including the use of futures market. Designed for master of agriculture program only.

Econ 537. Commodity Markets: Structure, Analysis, and Strategy. (3-0) Cr. 3. S. *Prereq:* 501 or 532 or 601, concurrent or previous enrollment in Econ 571 or Stat 328. Analysis of commodity markets, their function and performance. Price forecasting in commodity markets; futures market theory and hedging strategy evaluation; options theory and strategy evaluation.

Econ 538. Econometric Statistics. (Same as Stat 538.) See *Statistics*.

Econ 539. Game Theory. (Same as Stat 539.) See *Statistics*.

Econ 544. Public Economics I. (3-0) Cr. 3. F. *Prereq:* 501 or 601. Pure public goods and impure public goods; externalities; open access and common property resources; market and club provision of excludable public goods; Lindahl and Nash equilibria; collective action.

Econ 545. Public Economics II. (3-0) Cr. 3. S. *Prereq:* 501 or 601. Preference revelation mechanisms; voting models, experiments and public economics; nonprofit sector; optimal taxation; partial and general equilibrium analysis of tax shifting and tax incidence, excess burden of tax; tax competition.

Econ 553. Applied Research in Monetary and Macroeconomics. (3-0) Cr. 3. F. *Prereq:* 502, 571. Application of economic theory to the analysis of contemporary issues in macroeconomics, monetary economics, and financial economics. This is a Master's level course.

Econ 555. Issues in International Economics. (3-0) Cr. 3. S. *Prereq:* 501, 502. Theories of international trade and finance. Emphasis on current policy issues in international economics. This is a Master's level course.

Econ 560. Agricultural Policy. (3-0) Cr. 3. S. *Prereq:* 501 or 601. Effects of and motivation for government intervention in agriculture. Review of instruments of intervention; efficiency of redistribution; social choice theory. Trade and stabilization policies. Effects of environmental policies on agriculture.

Econ 563. Issues in Government Policy Affecting Agriculture. (2-0) Cr. 2. *Prereq:* 101. Off campus. Offered as demand warrants. Government policy and the policy-making process as it affects food, agriculture, and trade. Description and analysis of government policies and programs designed to address production agriculture problems and consumer food concerns. Evaluation of the interaction of agriculture and world trade as affected by U.S. and foreign government policies. Designed for master of agriculture program only.

Econ 566. Advanced Agricultural Finance. (3-0) Cr. 3. *Prereq:* 501 or 601; Fin 550 recommended. Modern financial theories of the firm applied to agriculture; models of capital structure of farm firms; investment under uncertainty; capital asset pricing in agriculture; land pricing; agency problems and financial contracting; formal and informal financing of agricultural production, including equity, debt, leasing, and other contractual arrangements; relationship between real and financial decisions; evolving financial markets and financial institutions for agriculture; market imperfections in rural financial markets, public policy issues, and government intervention.

Econ 571. Intermediate Econometrics. (3-0) Cr. 3. S. *Prereq:* 500. Single and multiple equation regression models; dummy explanatory variables; serial correlation; heteroskedasticity; distributed lags; qualitative dependent variables; simultaneity. Use of econometric models for tests of economic theories and forecasting.

Econ 573. Econometrics I. (3-0) Cr. 3. S. *Prereq:* 501 and Stat 447 or 542. Specification, estimation, and testing of single and multiple equation models of economic processes; qualitative choice and limited dependent variable models; examination and evaluation of empirical studies in the economics literature.

Econ 574. Econometrics II. (3-0) Cr. 3. SS. *Prereq:* 573. Large sample properties of estimators and large sample inference; dynamic models and instrumental variables; identification, estimation, and evaluation of systems of simultaneous equations; introduction to time series methods and applications, including alternative variance specifications.

Econ 576. Regional Economics. (3-0) Cr. 3. S. *Prereq:* 501. Analysis of location choice by firms, employees, and households emphasizing the role of spatial variations in agglomeration economies, economies of scale, distance, transport, endowments, amenities, and local government. Models of land use, urban form, spatial competition, central place theory, and migration. Techniques of discrete choice analysis, statistical analysis of categorical data, urban system modeling, and interregional computable general equilibrium.

Econ 581. Advanced Environmental Economics. (3-0) Cr. 3. S. *Prereq:* 501 or 601. Interrelationships of natural resource use and the environment. Applied welfare and benefit-cost analyses. Externalities and pollution abatement. Nonmarket valuation of resources. Property rights. Legal and social constraints. Policy approaches.

Econ 583. Water Resources. (Same as W Res 583.) (3-0) Cr. 3. S. *Prereq:* Graduate classification; not for economics majors. Analysis of water resource management issues from economic, legal, political, and sociological perspectives. Topics include rational water allocation systems, market failure, investment, pollution control strategies, and resource management. Administered by Economics in cooperation with Political Science and Sociology.

Econ 585. Economic Growth and Development. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 501 and 502 or 601 and 602. Performance and problems of developing countries in relation to growth, employment, structural change, and human development; theories and paradigms of development; theories and sources of economic growth; policies to promote industrialization and trade; role of agriculture; farm size and

tenure in relation to productive efficiency and technology adoption; generation and diffusion of new agricultural technology; fertility, population growth, and sustainability; income distribution, poverty; foreign aid and development strategies adopted by countries and international lending agencies.

Econ 586. Microfoundations of Economic Growth and Development. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 501 and 502 or 601 and 602. Models of household and firm/farm behavior in developing countries. Computable general equilibrium models. General equilibrium incidence of large investment projects, technological change, and market interventions. Models of endogenous growth. Convergence and productivity. Analysis of large data sets.

Econ 590. Special Topics. Cr. 1 to 5 each time taken. Offered on a satisfactory-fail grading basis only.

Econ 599. Creative Component. Cr. 1 to 5. Offered on a satisfactory-fail grading basis only.

Courses for Graduate Students, major or minor.

Econ 600. Quantitative Methods in Economic Analysis II. (3-0) Cr. 3. F. *Prereq:* 500 or equivalent background in calculus. Introduction to elements of nonlinear programming, comparative static analysis, difference and differential equations, probability, statistics, and game theory useful for micro- and macroeconomic modeling.

Econ 601. Microeconomic Analysis I. (4-1) Cr. 4. F. *Prereq:* 301, previous or concurrent enrollment in 600 and permission of Director of Graduate Studies. Economic theory and methodology; theory of consumer behavior, theory of the competitive firm, supply and factor demand; duality relations in consumer and producer theory, partial equilibrium analysis, stability and comparative statics; introduction to game theory; theory of imperfect competition.

Econ 602. Macroeconomic Analysis. (4-1) Cr. 4. S. *Prereq:* 301, 302, previous or concurrent enrollment in 600 and permission of Director of Graduate Studies. Analysis of static and dynamic models of aggregate economic activity with an emphasis on the role of fiscal and monetary policies on the determination of GNP and its distribution, the price level, and labor employment.

Econ 603. Microeconomic Analysis II. (4-1) Cr. 4. S. *Prereq:* 601, 602 and permission of Director of Graduate Studies. General equilibrium analysis, efficiency, and welfare; market failures, externalities, and the theory of the second best; uncertainty and economic theory; producer supply and factor demand decisions under uncertainty; portfolio and savings decisions under uncertainty; value of information; applications of game theory to economic analysis.

Econ 604. Advanced Macroeconomic Analysis. (4-1) Cr. 4. F. *Prereq:* 601, 602 and permission of Director of Graduate Studies. Introduction to microtheoretic-based dynamic and stochastic macroeconomic models applied to the study of economic growth, business cycles, and governmental policies.

Econ 605. Advanced Topics in Microeconomics. (3-0) Cr. 3 each time taken. *Prereq:* 603, 604. Selected topics in microeconomic theory of current significance to the profession.

Econ 606. Advanced Topics in Macroeconomics. (3-0) Cr. 3 each time taken. *Prereq:* 603, 604. Selected topics in macroeconomic theory of current significance to the profession.

Econ 608. Noncooperative Game Theory and Information Economics. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 603 or 501 and permission of instructor. The noncooperative theory of strategic and extensive form games. Nash equilibrium, subgame perfection, and other refinements, and other solution concepts such as iterated dominance. Supergames. Applications in information economics such as bargaining, auctions, signaling, reputation building, and the principal-agent problem.

Econ 616. Industrial Organization II. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 515. Theoretical and empirical studies of industry structure, conduct, and perfor-

mance. Review of game theory. Technological innovation and diffusion. Mergers. Vertical integration and contractual alternatives. Antitrust. Regulation and regulated industries.

Econ 635. Agricultural Price Analysis. (3-0) Cr. 3. F. *Prereq:* 601. Application of price theory to agricultural market analysis. Agricultural product supply and input demand. Uncertainty and risk, expectations, and supply dynamics. Retail demand and derived demand for farm products. Competitive equilibrium of agricultural markets. Vertical market relations and marketing margins. Storage and price relations over time. Price discovery and risk allocation with futures markets. Industrial organization of agricultural markets and imperfectly competitive models of the agricultural and food industry.

Econ 639. Consumption and Demand Analysis. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 601. Analysis of demand with emphasis on the theory of consumption decisions, the development and estimation of models, and the assessment and interpretation of empirical results. Demand systems, flexible functional forms, separability and aggregations, dynamic models. Household consumption models, demographics, equivalence scales, cost-of-living indices, standard of living measurement, and quality of goods. Empirical and experimental applications with emphasis on food demand. Extensions and policy issues related to marketing regulations, food assistance programs, poverty, nutrition, food safety, and health.

Econ 640. Advanced Topics in Agricultural Economics. (3-0) Cr. 3 each time taken. *Prereq:* 603, 604. Selected topics in agricultural economics of current significance to the profession.

Econ 641. Production Economics with Agricultural Applications. (3-0) Cr. 3. S. *Prereq:* 601, concurrent or previous enrollment in 573. Advanced treatment of agricultural production and supply; estimation of production functions, functional forms, and duality; alternative representations of technology, including distance, cost, revenue, and profit functions. Technological change and productivity; parametric and nonparametric estimation of technology and supply relationships; dynamic models; decisions under uncertainty; stochastic production relationships, strategic uncertainty, the role of information and insurance.

Econ 653. Financial Economics. (3-0) Cr. 3. F. *Prereq:* 603, 574. *Recommended:* 674, Stat 551. Review of decision-making under uncertainty. Portfolio Theory. Theoretical foundations of asset valuation models: capital asset pricing model (CAPM), arbitrage pricing theory (APT), representative agent models, pricing of derivative securities. Complete and incomplete asset markets, credit markets, financial intermediaries, the role of government in the financial sector. Market frictions, crashes, bubbles. Applications of asset valuation models, with emphasis on their testable implications.

Econ 654. Economic and Financial Institutions: Structure and Purpose. (3-0) Cr. 3. S. *Prereq:* 603 or understanding of perfect Bayesian equilibrium. The theory of agency, moral hazard, and mechanism-design. Uncertainty and the role of markets and firms in society. Transaction costs and vertical integration. Bargaining theory and optimal property rights. Implicit contracts and informal power. Applications to agricultural institutions, debt financing, and corporate governance (equity financing).

Econ 655. International Trade. (3-0) Cr. 3. F. *Prereq:* 603. Modern theory of international trade; welfare and distributional aspects of trade and tariffs. The interdependence of international trade and economic growth. Optimal trade policies in the presence of such distortions as unemployment, monopolies and cartels, balance of payments problems, infant industries, and common market areas.

Econ 657. International Finance. (3-0) Cr. 3. S. *Prereq:* 604. The theory of exchange rate and balance of payments determination; open-economy macroeconomic issues; and current account adjustment. Emphasis on the current empirical literature concerning the efficient market theory of the foreign exchange market.

Econ 660. Welfare Theory. (3-0) Cr. 3. *Prereq:* Credit or enrollment in 603. Notions of economic efficiency, equivalent, and compensated variation measures, consumer and producer surplus, market failures, social choice, path independence, compensated demand curves, cost-benefit evaluation, and public choice.

Econ 674. Macroeconometrics. (3-0) Cr. 3. F. *Prereq:* 601, 602, 571. Balanced treatment of time-series econometric techniques and their application to macroeconomics and financial markets. Techniques include GARCH and ARCH-M models, unit-root tests, nonlinear adjustment models, structural VARs, and cointegration tests.

Econ 675. Advanced Topics in Econometrics. (3-0) Cr. 3 each time taken. *Prereq:* 538 or 574, Stat 543 recommended. Advanced treatment of issues important in econometrics. Topics chosen from asymptotic theory, nonlinear estimation, Bayesian and robust econometrics, econometric time series, limited dependent variables and censored regression models, nonparametric and semiparametric methods, bootstrapping and Monte Carlo techniques, etc.

Econ 680. Advanced Resource Economics. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 603. Dynamic allocation of scarce, exhaustible, and renewable natural resources, including minerals and energy, soil, water, forests, and fish. Social versus private decisions. Market and nonmarket considerations. Technological change. Regulation. Dynamics and uncertainty.

Econ 690. Advanced Topics. Cr. 1 to 5 each time taken. Offered on a satisfactory-fail grading basis only.

Econ 693. Workshops. Cr. 1 to 3 each time taken. *Prereq:* 6 graduate credits in chosen field. Offered on a satisfactory-fail grading basis only.

Econ 699. Research for Thesis or Dissertation. Offered on a satisfactory-fail grading basis only.

Educational Leadership and Policy Studies

John H. Schuh, Chair of Department

University Professors: Manatt, Robinson

Professors: Blake, Ebbers, English, Gmelch, Huba, Littrell, Moore, Owen, Schuh, Steffy, Van Ast

Professors (Collaborators): Barak, Gardner

Distinguished Professors (Emeritus): Ahmann, Fanslow, Warren

Professors (Emeritus): Beavers, Boyles, Bryan, Engel, Hopper, Jones, Kizer, Lagomarcino, Lawrence, McCandless, Netusil, Pellegrino

Associate Professors: Evans, Gilley, Licklider, Poston

Associate Professors (Adjunct): Stow

Associate Professors (Emeritus): Thielen

Assistant Professors: Hackmann, Hall, Hamrick, Mullen

Assistant Professors (Adjunct): Ahrens, Andersen, Arthur, Hill, Jackson, Kruempel, MacKay, Payne, Robinson, Stanley, Zacharakis-Jutz

Graduate Study

The Departments of Educational Leadership and Policy Studies and Curriculum and Instruction offer work for the degrees master of science, master of education, and doctor of philosophy with a major in education. They also offer minor work to students majoring in other fields of study. In the Department of Educational Leadership and Policy Studies, students may complete the Ph.D. with a major in education and a specialization in educational leadership. At the master's level, students may specialize in counselor education; educational administration; higher education; historical, philosophical, and comparative studies in education; organizational learning and human resource development research and evaluation; and vocational technical education (master of education only). See the *Department of Curriculum and Instruction* for further discussion of the education major without specialization and with specialization in elementary education, special education, and curriculum and instructional technology.

Prerequisite to major graduate work in educational leadership is completion of an undergraduate degree with coursework appropriate to the planned specialization and adequate proof that the student ranks above average in scholastic ability and promise of professional competence.

Doctoral students in Educational Leadership and Policy Studies will complete seminars, laboratory experiences, field experiences, and independent research that will enable them to serve as leaders in various educational settings including school administration, community colleges, public and private colleges and universities, and public and private agencies. In addition to the common experiences noted above, students will each select an intellectual content area that will prepare them to work in the setting of their choice. Specific information about the requirements of the Ph.D. degree is available from the departmental office.

Graduates of this program possess skills and knowledge related to six core domains: educational leadership, educational research, communication, educational evaluation, educational foundations, and educational technology. They are able to work effectively with individuals and groups, engage in ethical decision-making and management of resources to accomplish goals. They comprehend the basic elements of research and inquiry and engage in scholarly inquiry. Graduates express ideas clearly both orally and in writing, understand themselves well and relate sensitively to individuals from diverse backgrounds. They understand and can use intelligently the principles of program evaluation and assessment. Graduates have a clear understanding of the foundations of education; their work is well grounded in theory and philosophy. They also understand the role and applications of technology in learning and organizational processes. Graduates are knowledgeable about the concepts, theories, and practices related to the educational content area emphasized in their studies.

Other graduate programs related to education (including General Graduate Studies) may be planned for students on the basis of previous education and experiences as well as future plans and needs. Students should refer to Agricultural Education and Studies, Curriculum and Instruction, Family and Consumer Sciences Education and Studies, Health and Human Performance, Industrial Technology, and General Graduate Studies or to graduate level course offerings within other departments.

The department participates in the interdepartmental programs of gerontology, and housing.

Courses for Graduate Students Counselor Education (Co Ed)

John M. Littrell, Program Coordinator

The counselor education program places a dual emphasis on the development of professional school counselors and on the academic/scholarly aspects of the counseling profession. Students are provided an opportunity for practical experience in a variety of settings.

Counselor education graduates are prepared for entry level positions as counselors in elementary and secondary schools. Graduates are educational leaders who are able to promote and enhance student learning through the three broad and interrelated areas of student development - academic, career, and personal/social. Graduates are skilled in the primary delivery methods for effective school counseling programs; counseling, consultation, collaboration, coordination, case management, guidance curriculum, and program evaluation.

Students desiring graduate work in counselor education leading to the master of science degree or master of education degree may elect one of two programs: elementary school counseling or secondary school counseling.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Co Ed 529. Foundations of Counseling. (3-0) Cr. 3. F. *Prereq:* 8 credits in undergraduate education, sociology, or psychology. Research theory and conditions that facilitate behavioral change in individuals.

Professional roles and functions, professional organizations and associations, professional history and trends, ethical standards and legal issues, professional preparation standards, and professional credentials.

Co Ed 531. Microcounseling. (1-2) Cr. 3. F. *Prereq:* Credit or enrollment in 529. Building skills in listening, responding, and developing counseling relationships.

Co Ed 540. Developmental Counseling. (3-0) Cr. 3. S. *Prereq:* Credit or concurrent enrollment in 529. Understanding and counseling clients on the basis of developmental theory and critical incidents. An opportunity to integrate related concepts, e.g., transitions, crises, career development, and choice theories as part of a client's life cycle.

Co Ed 551. Occupational Choice and Development. (3-0) Cr. 3. S. *Prereq:* 529. Developmental and social factors influencing career choice. Theories, assessment instruments, classification systems, and informational sources used in career counseling.

Co Ed 555. Individual and Group Assessment. (3-0) Cr. 3. SS. *Prereq:* 529. Individual and group approaches to assessment and evaluation. Theoretical and historical bases, validity, reliability,

methods, psychometric statistics, pertinent factors related to assessment and evaluation, strategies with instruments, applications, and ethical considerations.

Co Ed 560. Counseling Theories and Models. (3-0) Cr. 3. F. *Prereq:* 529. Understanding of counseling process with focus on counseling theories including both individual and systems perspective as well as coverage of relevant research and factors considered in application. How counseling theory aids counselors in conceptualizing client concerns and facilitating client choice and/or behavioral change.

Co Ed 561. Counseling Techniques. (2-2) Cr. 3. S. *Prereq:* 531, 560. Utilizing counseling theory to provide focus, organize client's related experiences into sequence, steps and patterns; utilizing the interpersonal process variables in counseling; choosing and implementing interventions that are client and problem specific. The laboratory provides students an opportunity to apply that which is learned through reading, lecture, and class discussions.

Co Ed 569. Group Process. (2-2) Cr. 3. F. *Prereq:* 531, 560. Ethics for group leaders; planning, implementing, and facilitating groups. Dynamics and leader interventions at various group stages. Participation in group laboratory activities.

Co Ed 572. Management of School Counseling Programs. (3-0) Cr. 3. F. *Prereq:* 531. Design, implementation, and evaluation of a comprehensive developmental school program; coordination with resource persons, specialists, business, and agencies outside the school to promote program objectives; promotion of the program within the total school community; integration of guidance curriculum in the total school curriculum; data gathering methods for program planning and evaluation; time management; and referral procedures.

Co Ed 573. Implementing Community Counseling Programs. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 531. Historical, philosophical, societal, cultural, economic, and political dimensions of the mental health movement; roles of mental health counselors in a variety of practice settings; relationships between mental health counselors and other professionals in these settings; organization, fiscal, and legal dimensions of the institutions and settings in which mental health counselors practice; general principles of community intervention, consultation and outreach; evaluation of programs and systems.

Co Ed 576. Social and Cultural Issues in Counseling. (3-0) Cr. 3. S. Alt. SS., offered 2001. *Prereq:* 560, and 561 or 565. Issues and trends in a multicultural and diverse society. Focus on multicultural and pluralistic trends including characteristics and concerns of diverse groups, attitudes and behavior based on such factors as ethnicity and culture; individual, family, and group strategies with diverse populations; and ethical considerations.

Co Ed 580. Practicum in Community Counseling. Cr. 3. F.S. *Prereq:* 561 or 565. Designed for students who desire counseling experience in a community/agency setting. Practicum experience can be arranged at urban centers, detention facilities, MDTA centers, vocational rehabilitation centers, etc.

Co Ed 581. Practicum in Secondary School Counseling. Cr. 3. F.S. *Prereq:* 561. Placement in a secondary and/or junior high school. The practicum student will perform various role functions expected of the school counselor. Emphasis on individual and group counseling functions.

Co Ed 582. Practicum in Elementary School Counseling. Cr. 3. F.S. *Prereq:* 565. Placement in an elementary school. Counseling students, consulting with teachers and parents and coordinating activities that enhance student development and growth both in the cognitive and affective domains.

Co Ed 590. Special Topics. Cr. 1 to 2. *Prereq:* 10 graduate hours in counselor education.

Co Ed 593. Workshop in Counseling and Guidance. Cr. 1 to 3. SS. *Prereq:* 10 hours in counselor education. Workshops are designed to give practicing counselors an in-depth exposure to a counseling issue or a counseling model with concurrent opportunity for application of the model. Offered

when demand warrants.

- A. Brief Counseling
- D. Substance Abuse Counseling
- H. Crisis Intervention
- I. Theoretical Issues
- J. School Counseling
- K. Counseling Issues

Co Ed 599. Creative Component. Cr. 1 to 2. *Prereq:* 10 credits in counselor education.

Courses for Graduate Students

Co Ed 610. Group Counseling Practicum. Cr. 1. F.S.SS. *Prereq:* 580, or 581, or 582 and permission of instructor. Supervised experience facilitating and processing groups.

- A. Skill Training Lab
- B. Counseling Group

Co Ed 611. Internship. Cr. 3 to 6. F.S. *Prereq:* 580, or 581, or 582. A student intern performs all activities that regularly employed staff members in a counseling setting perform.

Co Ed 615. Seminar. Cr. 1 to 2. *Prereq:* 10 hours in counselor education. Seminars are designed to meet various needs of advanced master's students and practicing counselors. Offered when demand warrants.

- C. Current Issues and Trends in Counseling
- D. Consultation
- F. Group Intervention Strategies

Co Ed 620. Supervision of Counseling. Cr. 2. F.S. *Prereq:* 620. Minimum of 3 practicum credits and permission of instructor. Advanced counseling students provide clinical supervision for students enrolled in 580, 581, and/or 582.

Co Ed 690. Advanced Special Topics. Cr. arr. *Prereq:* 10 credits in counselor education.

Co Ed 699. Research. Cr. arr. *Prereq:* 10 credits in counselor education.

Educational Administration (EdAdm)

Fenwick English, Program Coordinator

The educational administration program places dual emphasis on preparation of professional educational administrators and on the academic/scholarly aspects of educational leadership and management. Courses taken do not apply toward a degree without official admission to the educational administration program.

Graduates of Master's degree programs in educational administration are prepared for leadership roles in K-12 school districts and education agencies, typically as building-level principals and assistant principals.

Specifically, graduates are knowledgeable about the following leadership skills as they develop schools into learning communities: leadership, problem analysis, and organizational oversight; curriculum design, instructional delivery, resource allocations, and staff development; human relationships and interpersonal influences, legal applications, and public relations.

Graduates of the Certificate of Advanced Studies program possess administrative and leadership skills necessary for the superintendency. These include knowledge of child and adolescent development, the educational environment, curriculum and instructional practice, law and ethics; management of systems, personnel, and finances; interpersonal communication and community relationships.

Several programs are offered: (1) the Master of Science degree, both thesis and nonthesis, in elementary or secondary school administration; (2) Master of Education practitioner, (3) advanced study leading to principal's license;

(4) Certificate of Advanced Studies providing post master's training for superintendency licensure. Courses are scheduled with consideration for cohort-collegial teams or groups.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

EdAdm 541. Principles of Educational Administration. (3-0) Cr. 3. F.SS. *Prereq: Teacher licensure and permission of instructor.* Purposes of education in a democratic society. Basic principles of school administration and educational organization planning. Analysis of the nature and function of units of education at local, intermediate, and state levels; exploration of substantive elements such as leadership, change process, strategic and operational planning, and current issues in education.

EdAdm 543. The Administration of School Personnel. (3-0) Cr. 3. S.SS. *Prereq: 541.* Group dynamics; selection and deployment of the teaching and administrative staff; employee involvement, e.g., Quality Circles; and organizational development and facilitation, experiences in interviewing; professional and human resources development.

EdAdm 546. School Business Management. (2-0) Cr. 2. S.SS. *Prereq: 541.* Functions and duties of the school business manager; school plant planning; financial management and banking; investment of funds; risk management; cash flow projections; accounting practices; food services; transportation; purchasing; managing the business office; fiscal information systems.

EdAdm 547. School Public Relations. (2-0) Cr. 2. F.SS. *Prereq: 541.* Planning and executing a successful school public relations program; roles and responsibilities in the public relations program; internal and external public relations influences; community relations and communications.

EdAdm 548. Policy Development and Issues: Organizational Roles and Responsibilities. (2-0) Cr. 2. S.SS. *Prereq: 541.* Functions of the superintendent and school board in policy making and organizational quality improvement; problems of interpreting and implementing policy. Community leadership and relationships between the functions of the superintendent and school board.

EdAdm 549. School Strategic, Operational, and Facility Planning. (2-0) Cr. 2. F.SS. *Prereq: 541.* Belief systems; external and internal scanning, mission; visioning; strategic goals; objectives; tactics, action plans; planning tools; and organizational improvement.

EdAdm 555. The Organization and Administration of Schools for the Adolescent. (2-0) Cr. 2. S.SS. *Prereq: 541.* Leadership of schools for early adolescents. Focus on middle school concept, development studies, curriculum, and program administration and supervision for early adolescent learners in an atmosphere of positive group dynamics and community building.

EdAdm 557. Supervision of Instruction. (3-0) Cr. 3. F.SS. *Prereq: 541.* Evaluating and improving the performance of teachers and administrators of K-12 public and independent schools, intermediate educational units, and community colleges. This offering meets the requirement for initial evaluator training necessary for licensure in Iowa.

EdAdm 575. Fundamentals of School Law. (3-0) Cr. 3. S.SS. *Prereq: 541.* Constitutional, statutory, and judicial provisions as a basis for the legal operation of public schools. The law is examined as it affects the local school district, boards of education, administrators, teachers, and students at the elementary and secondary school levels.

EdAdm 576. The Administration of Elementary Schools. (3-0) Cr. 3. S.SS. *Prereq: 541.* Patterns of elementary school organization; educational leadership through supervision, curriculum development, and in-service education. Administering pupil and auxiliary services; staff and community relations.

EdAdm 577. The Administration of Secondary Schools. (3-0) Cr. 3. S.SS. *Prereq: 541.* Secondary

school organization, schedule making, management of pupil organizations, evaluation of pupil growth. Evaluation of the total program, staff utilization, and leadership.

EdAdm 578. Administrative Theory in Education. (3-0) Cr. 3. F.SS. *Prereq: 541.* Current thinking in administration and organization, theoretical approaches to administration; analysis of functions and processes of administration as they apply to education.

EdAdm 580. Administration of Special Education and Services. (3-0) Cr. 2. F.SS. *Prereq: 541.* Administration of special education programs. Current problems and practices of special education, exceptional child, and individualized educational program administration.

EdAdm 590. Special Topics. Cr. 1 to 4. *Prereq: 9 credits in education.*

EdAdm 591. Supervised Field Experience. Cr. 1 to 8. *Prereq: 541 and admission to program and instructor's approval.* Supervised on-the-job field experience in special areas.

- A. Elementary Principal.
- B. Secondary Principal.
- C. Superintendency/Central Office.

EdAdm 593. Workshops. Cr. 1 to 4. *Prereq: 9 credits in education.*

EdAdm 599. Thesis Research or Creative Component Development. Cr. 1 to 3. *Prereq: 9 credits in educational administration.*

Courses for Graduate Students

EdAdm 615. Seminar. Cr. 1 to 3. In-depth study of administrative topics of contemporary interest and importance.

- A. Client Focus
- B. Research
- C. Quality Improvement
- D. Special Services
- E. Assessment
- F. Leadership

EdAdm 641. Administrative Problems. (3-0) Cr. 3. F.SS. *Prereq: 541.* A case study approach to the resolution of problems in educational administration. Emphasis on decision-making, conflict resolution, and communication using actual situations.

EdAdm 643. Public School Negotiations. (2-0) Cr. 2. S.SS. *Prereq: 543.* Collective bargaining in the public sector; master contract analysis; negotiation simulations; selected topics such as contract administration, compensation management, and organizational dimensions.

EdAdm 644. School Finance. (2-0) Cr. 2. S.SS. *Prereq: 541.* Current issues in school finance; tax structures; multiple state aid models; federal financial aid programs; Iowa's finance model; developing, communicating, and monitoring a school district budget, bond issues, tax anticipation and bond anticipation notes; the economic and political context of school finance.

EdAdm 657. Advanced Supervision of Instruction. (2-0) Cr. 2. F.SS. *Prereq: 557.* Theory, strategies, and systems for supervising programs and personnel in school districts and independent schools. Focuses on the principal, cabinet level administrator, e.g., director, headmaster, or assistant superintendent for instruction. This course meets the requirement for advanced evaluator training for licensure in Iowa.

EdAdm 676. Instructional Management. (2-0) Cr. 2. F.SS. *Prereq: 576 or 577.* Techniques for managing the instructional program according to the theory and principles of curriculum design, delivery, and assessment.

EdAdm 679. Contemporary Management Strategies. (2-0) Cr. 2. S.SS. *Prereq: 578.* Critical analysis of major research in curriculum, management systems, communication theory, and group facilitation as it applies to the governance and management of educational and other public institutions; staff development techniques and theories, individual, group, and organizational development strategies, curriculum design and delivery, and assessment.

EdAdm 681. Current Practices of the Superintendency. (3-0) Cr. 3. S. *Prereq: 541.* Examination of current practices and tasks of the superintendent via seminar-type interaction with superintendents and other practitioners.

EdAdm 690. Advanced Special Topics. Cr. 1 to 3. *Prereq: 9 credits in educational administration.*

EdAdm 699. Dissertation Research. Cr. arr. *Prereq: 9 credits in education.*

Higher Education (Hg Ed)

Nancy J. Evans, Program Coordinator

The higher education program provides graduate instruction and leadership development in community college education, student affairs practice, institutional research, post-secondary curriculum, and higher education administration. The master of science with thesis or non thesis option and master of education degrees are offered as well as postgraduate professional development and community college licensure courses. Students desiring community college licensure must have a master's degree in a subject matter area, complete a human relations requirement, and complete the following courses: Hg Ed 561, 562, and 582. Contact the program coordinator for additional information. An M.Ed. in Vocational Technical Education for Community College Practitioners is provided with an emphasis on learning and teaching leadership.

Graduates of master's degree programs in higher education and community college vocational technical education are prepared for entry level positions in student affairs administration, general institutional administration, teaching positions in community colleges and support positions in post secondary settings.

Specifically, graduates are knowledgeable about the development of college students, organization and administration of post secondary institutions, how college students learn, program development, advising college students, ethical issues in colleges and universities, and basic research and evaluation techniques.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Hg Ed 420. Introduction to Vocational Technical Teaching at Community Colleges. (3-0) Cr. 3. F. Examines the competencies for successful teaching in vocational technical programs; a focus on lesson planning, motivating students, teaching methods, time management, and evaluation. Materials fee.

Hg Ed 421. Vocational Technical Teaching Methods at Community Colleges. (Dual-listed with 521.) (3-0) Cr. 3. S. *Prereq: 420.* Develops competencies necessary to identify, develop, implement, and evaluate collaborative learning, learning to learn, and other classroom and lab/clinic teaching techniques. Materials fee.

Hg Ed 422. Vocational Technical Curriculum at Community Colleges. (Dual-listed with 522.) (3-0) Cr. 3. F. *Prereq: 421.* Develops competencies necessary to identify, develop, implement, and evaluate outcome-based vocational courses and programs in community colleges with a focus on alignment and accountability. Materials fee.

Hg Ed 423. Vocational Technical Assessment at Community Colleges. (Dual-listed with 523.) (3-0) Cr. 3. S. *Prereq: 422.* Develops competencies necessary to identify, develop, empower, and evaluate teaching and learning success with a focus on classroom assessment. Materials fee.

Hg Ed 500. Higher Education and Student Affairs Practices. (1-0) Cr. 1. *Prereq: Admission to the master's program in higher education and permission of instructor.* For master's degree students. Primary literature in higher education, resources, careers, professional organizations and programs. Particular emphasis on student affairs practice.

Hg Ed 504. Higher Education in the United States. (3-0) Cr. 3. *Prereq: Graduate classification.* Historical development: diversity, functions, and philosophies of colleges and universities; federal and state roles; general, liberal, technical, graduate, and professional education.

Hg Ed 521. Vocational Technical Teaching Methods at Community Colleges. (Dual-listed with 421.) (3-0) Cr. 3. S. *Prereq: 420.* Develops competencies necessary to identify, develop, implement, and evaluate collaborative learning, learning to learn, and other classroom and lab/clinic teaching techniques. Materials fee.

Hg Ed 522. Vocational Technical Curriculum at Community Colleges. (Dual-listed with 422.) (3-0) Cr. 3. F. *Prereq: 521.* Develops competencies necessary to identify, develop, implement, and evaluate outcome-based vocational courses and programs in community colleges with a focus on alignment and accountability. Materials fee.

Hg Ed 523. Vocational Technical Assessment at Community College. (Dual-listed with 423.) (3-0) Cr. 3. S. *Prereq: 522.* Develops competencies necessary to identify, develop, empower, and evaluate teaching and learning success with a focus on classroom assessment. Materials fee.

Hg Ed 550. Teaching, Learning and Leadership. (3-0) Cr. 3. F. *Prereq: Teacher licensure.* Current issues and practices in community college teaching, and learning and the role and responsibilities of teachers as leaders.

Hg Ed 561. College Teaching. (2-0) Cr. 2. *Prereq: 6 graduate credits.* Educational theory, methods, and strategies for the improvement of college instruction. Significance of adult learning styles, academic disciplines, and teaching styles in relation to college instruction.

Hg Ed 562. Curriculum Development in Colleges. (3-0) Cr. 3. *Prereq: Graduate classification.* Modes of curriculum design, development, and change in colleges. Development of curricular leadership and evaluation strategies.

Hg Ed 563. College Personnel Policies and Practices. (3-0) Cr. 3. *Prereq: 504.* Personnel management and problems, in-service development, salaries and fringe benefits, promotions, tenure, retirement, and recruitment practices. Faculty and staff evaluation procedures and collective bargaining.

Hg Ed 568. Global Education Policy Analysis. (3-0) Cr. 3. *Prereq: 504.* Assessment of global education policy issues in education. Analysis of policies, implementation strategies, and policy outcomes.

Hg Ed 570. Current Topics in Student Affairs. Cr. 1 to 3. *Prereq: Graduate classification.* Current issues and new directions in student affairs practice. Topics developed to the specific needs of student affairs professionals. Primarily for off-campus.

- A. Student Outcomes Assessment and Evaluation
- B. Admissions and Financial Aids
- C. Advising
- D. Residential Life
- E. Student Organizations and Activities
- F. Career Planning and Placement
- G. Student Affairs Institute
- H. Student Diversity

Hg Ed 574. Student Affairs Practice in Higher Education. (3-0) Cr. 3. *Prereq: Graduate classification.* An introduction to the field of affairs practice work with a consideration of student activities, counseling services, financial aids, admissions, student conduct, academic advising, and residential programs; includes community college programs.

Hg Ed 575. Organization and Administration of Student Affairs. (3-0) Cr. 3. *Prereq: 574.* Organization structures, role and function of student

affairs staff; policies and decision-making for student affairs practice.

Hg Ed 576. Student Development in Higher Education. (3-0) Cr. 3. S. *Prereq: 574.* The student development approach to student affairs practice. Theories of student development and their applications in student affairs programs, services, and activities. Implications of developmental theories with reference to issues such as career planning, academic programs, and moral development.

Hg Ed 577. Campus Environments and Cultures. (3-0) Cr. 3. Understanding of the impact of the college environment on students. Ability to use environmental theory to create positive learning situations for students.

Hg Ed 578. Students in American Higher Education. (3-0) Cr. 3. The course will study the relation between college students and characteristics from 1950 to the current day. Traditional assumptions about the impact of higher education on students will be reviewed and challenged. Campus issues and concerns relative to commuters and residential life will be discussed. Participants will analyze institutional responses to students through college missions, organizational development, structure, core curriculum and retention.

Hg Ed 579. Counseling and Group Dynamics in Post-secondary Settings. (3-0) Cr. 3. Development of effective basic counseling skills. Understanding of group dynamics. Ability to work effectively in groups.

Hg Ed 580. Current Topics in Community Colleges. (1-3) Cr. 1 to 3. *Prereq: Graduate classification.* Current issues and new directions in community college education. Topics developed to the specific needs of colleges. For off-campus.

- A. Student Needs
- B. General and Liberal Education
- C. Counseling and Advising
- D. Adult and Continuing Education
- E. Development and Remedial Education
- F. Student Services
- G. Faculty and Staff Evaluation
- H. Organization and Administration
- I. Learning and Teaching

Hg Ed 582. The Comprehensive Community College. (3-0) Cr. 3. *Prereq: Graduate classification.* The community college as a unique social and educational institution: its history, philosophy, functions, programs, faculty and student characteristics, organization and finance, trends, and issues. Reviews current research and exemplary community college practices internationally, nationally, and in Iowa.

Hg Ed 590. Special Topics. Cr. 1 to 4. *Prereq: 9 credits in education.*

- A. Student Services
- B. Community Colleges
- C. Current Issues
- D. International Higher Education
- E. Federal and State Affairs
- F. Law in Higher Education
- G. Institutional Research

Hg Ed 591. Supervised Field Experience. Cr. 1 to 4. *Prereq: 9 credits graduate work in special area.* Supervised on-the-job field experience in special areas.

Hg Ed 593. Workshops. Cr. 1 to 5. *Prereq: 15 credits in education.*

Hg Ed 597. Assessment and Evaluation in Student Affairs. (3-0) Cr. 3. Assessment and evaluation are integral in the measurement of quality in higher education. This course will explore various methodologies in the assessment and evaluation of programs and practices in post-secondary settings. Qualitative and quantitative approaches will be examined.

Hg Ed 598. Capstone Seminar. (3-0) Cr. 3. This course is designed to integrate the learning experiences of students completing the master's degree program in higher education. Such issues as ethics, continuing professional development, career planning and leadership will be explored.

Hg Ed 599. Creative Component. Cr. arr. *Prereq: 9 credits in education.*

Courses for Graduate Students

Hg Ed 615. Seminars in Higher Education. Cr. 1 to 4. F.S.SS.

- A. Student Services
- B. Community Colleges
- C. Current Issues
- D. International Higher Education
- E. Federal and State Affairs
- F. Law in Higher Education
- G. Institutional Research
- H. Research Designs in Higher Education

Hg Ed 664. College Organization and Administration. (3-0) Cr. 3. *Prereq: 504.* Administrative organization and behavior: communications, leadership, finance, strategic planning, and institutional governance.

Hg Ed 665. Financing Higher Education. (3-0) Cr. 3. *Prereq: 504.* Lectures, discussions, and individual investigation relating to financial administration in colleges and universities. Budgeting, auxiliary enterprises, administration of financial planning, fund raising, examination of theories on expenditures. Designed for persons aspiring to serving as college administrators.

Hg Ed 666. Academic Issues and Cultures. (3-0) Cr. 3. An examination of institutional culture and issues in higher education focusing on the roles and responsibilities of faculty and academic administrators.

Hg Ed 676. Student Development Theory II. (3-0) Cr. 3. Understanding of student development theory. Ability to use theory to guide student affairs practice.

Hg Ed 690. Advanced Special Topics. Cr. 1 to 4. *Prereq: 9 credits in education.*

Hg Ed 699. Research. Cr. arr. *Prereq: 9 credits in education.*

Historical, Philosophical, and Comparative Studies in Education (HPC)

David Owen, Program Coordinator

This program provides graduate experiences in historical, philosophical, and comparative studies in education. Students develop facility in analyzing educational problems and issues, critiquing policies that affect education in society, and making connections between educational practice and learning.

Work is offered toward the master of science with thesis or nonthesis option, and the master of education. These degree programs and classes are of benefit to classroom teachers, educational theorists, administrators, university personnel, youth workers, religious educators, and others who seek to understand better the numerous bases of contemporary systems of education. Study in this field also complements work in other areas of specialization in education.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

H P C 580. Qualitative Research Methodology. (3-0) Cr. 3. *Prereq: ResEv 550.* Qualitative research procedures in education, particularly historical, philosophical, biographical, ethnographic, and case study. Use of sources, principles of qualitative research, methods of data collection and analysis, field techniques, and writing of research results.

H P C 581. Philosophy of Education. (3-0) Cr. 3. *Prereq: 9 credits in education.* The bases of American educational theory and practice. Philosophical analysis of the viewpoints on education of selected individuals and groups.

H P C 584. Classics of Educational Philosophy. (3-0) Cr. 3. *Prereq: 9 credits in education.* Intensive study of influential statements of educational purpose, organization, curriculum, practice, and problems in the development of Western education.

H P C 585. Comparative Educational Systems: Industrialized Societies. (2 or 3-0) Cr. 2 or 3. *Prereq: 9 credits in education.* Examination of the principles and uses of comparative education in selected industrialized nations; analysis of the cultural foundations and institutional forms of education; recent movements for reform and innovation.

H P C 586. Comparative Educational Systems: Nonindustrialized Societies. (2 or 3-0) Cr. 2 or 3. *Prereq: 585.* Examination of the role of education in national development, educational systems, practices, and issues in selected nonindustrialized nations; the role of USAID, World Bank, and other donor agencies in educational planning.

H P C 588. History of American Education. (3-0) Cr. 3. *Prereq: 9 credits in education.* Historical analysis of selected educational policies, such as equal educational opportunity, governance, discipline, and teacher education. Biographies, school records, and government reports are examined. Antecedents to current issues are stressed.

H P C 590. Special Topics. Cr. 1 to 5. *Prereq: 9 credits in education.*

- A. History of Education
- B. Philosophy of Education
- C. Comparative Education
- D. Writing for Publication
- E. Qualitative Research

H P C 591. Supervised Field Experience. Cr. 1 to 6. *Prereq: 6 graduate credits in special area.* Supervised on-the-job field experience in special areas.

H P C 593. Workshops. Cr. 1 to 5. *Prereq: 9 credits in education.*

H P C 599. Creative Component. Cr. 1 to 3.

Courses for Graduate Students

H P C 602. Social and Philosophical Issues in Education. (3-0) Cr. 3 each time taken, maximum of 6. *Prereq: 9 credits in education.* A study in depth of selected educational issues, movements, or problems in American education.

H P C 615. Seminar. (1 to 3-0) Cr. 1 to 3.

- A. History of Education
- B. Philosophy of Education
- C. Comparative Education
- D. Writing for Publication
- E. Qualitative Research

H P C 690. Advanced Special Topics. Cr. 1 to 3.

H P C 699. Research. Cr. arr.

Organizational Learning and Human Resource Development (OLHRD)

Jerry W. Gilley, Interim Program Coordinator

The Organizational Learning and Human Resources Development (OLHRD) program prepares graduates for leadership roles in public and private organizations. The OLHRD program focuses primarily on the role and function of learning, change, and performance management in effective organizations. Graduates are expected to develop an understanding of the relationship among organizational learning, performance, and effectiveness and to develop skills and knowledge used to design, manage, and evaluate Organizational Learning and Human Resources Development efforts. The master of education (M.Ed.) is offered.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

OLHRD 540. Foundations of Organizational Learning and Human Resource Development. (3-0) Cr. 3. A study of the modern practice of organizational learning and human resource development from a perspective of its history, philosophy, application, and literature.

OLHRD 541. Adult and Organizational Learning. (3-0) Cr. 3. *Prereq: 540.* Examining how adults acquire and use knowledge, skills, attitudes within organizational settings; understanding individual differences in learning as well as the principles and elements of the learning organization.

OLHRD 542. Program Development and Evaluation in Human Resource Development. (3-0) Cr. 3. *Prereq: 540.* Applying program development and evaluation principles, models, and strategies to human resource development and performance improvement interventions.

OLHRD 543. Strategically Integrated Human Resource Development. (3-0) Cr. 3. *Prereq: 540, 541.* Examining the evolution and philosophy of human resource development, organizational transformation techniques, performance partnerships, changes in human resource development practice; and applying tools and techniques to improve organizational performance.

OLHRD 544. Performance Improvement and Change Through Learning Interventions. (3-0) Cr. 3. *Prereq: 541, 542.* Examining the characteristics and elements of the performance improvement and change process, with special attention to the roles and responsibilities employees, managers, and organizations engage in when improving individual and organizational learning.

OLHRD 545. Learning Acquisition and Transfer. (3-0) Cr. 3. *Prereq: 541, 542, 544.* Critical examination of learning acquisition and transfer barriers, partnerships, strategies, and activities; and the roles and responsibilities of human resource development professionals, managers, employees, and organizations in the application of learning on-the-job.

OLHRD 546. Human Resource Development Consulting. (3-0) Cr. 3. *Prereq: 543, 544.* Understanding the roles, responsibilities, characteristics, objectives, competencies, and skills of human resource development consultants; and applying the consulting process to solve performance and organizational problems in real and hypothetical settings.

OLHRD 547. Practicum/Internship. Cr. 3. Practicum or internship designed to provide work exposure in organizational learning and human resource development.

OLHRD 599. Creative Component. Cr. 3. *Prereq: 21 credits in organizational learning and human resource development.*

Research and Evaluation (ResEv)

Mary Huba, Program Coordinator

The research and evaluation program prepares professionals to work in the areas of assessment and program evaluation, and educational research with emphasis on statistics and computer applications. Work is offered toward the master of science degree with thesis.

Graduates of the program can articulate current issues and principles in research, program evaluation and assessment. They can implement various research and assessment approaches and evaluation models. They understand and effectively use principles and skills of research data analysis, and they prepare and interpret accurate and useful reports.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

ResEv 550. Educational Research. (3-0) Cr. 3. F.S.SS. *Prereq: 9 credits in education.* Understanding the nature of quantitative and qualitative research; reviewing the literature; developing research problems and questions; research designs; data collection and analysis issues; evaluating research studies.

ResEv 552. Basic Educational Statistics. (3-0) Cr. 3. F.S.SS. *Prereq: 550.* Statistical concepts and procedures for analyzing educational data. Descriptive statistics, correlation, t tests, and chi square with computer applications.

ResEv 553. Intermediate Educational Statistics. (2-1) Cr. 2. F.S.SS. *Prereq: 552.* A continuation of statistical concepts and procedures for analyzing educational data. Inferential techniques including simple and multiple regression, multiple ANOVA, etc., with educational computer applications.

ResEv 554. Intermediate Research Methods. (3-0) Cr. 3. S.SS. *Prereq: 550, H P C 580, Stat 401 or equivalent.* Intermediate quantitative and qualitative research methodology in preparation for carrying out thesis and dissertation research. Problem formulation; design; data collection and analysis; interpreting and summarizing research findings.

ResEv 557. Computer Data Analysis Procedures. (2-0) Cr. 2. F., Alt. SS., offered 2001. *Prereq: Stat 401 or equivalent.* Processing educational research data including coding, conversion and analysis strategies. Using interactive statistical software such as SPSS to examine, chart, and report findings.

ResEv 560. Assessing Student Learning. (3-0) Cr. 3. F. *Prereq: 550 or basic statistical skills.* The purpose and techniques of formal and informal classroom assessment. Rubrics, performance assessment, portfolios, paper and pencil tests, communicating assessment findings. Emphasis on both theory and practical applications.

ResEv 561. Program Evaluation. (3-0) Cr. 3. S.SS. *Prereq: 550.* Evaluation models and professional standards. Techniques of evaluating educational programs. Emphasis on both theory and practical applications.

ResEv 590. Special Topics. Cr. 1 to 3 each time taken. F.S.SS. *Prereq: Graduate standing.* Guided reading and in research and evaluation study on special topic.

ResEv 593. Workshop. Cr. 1 to 3 each time taken. F.S.SS. *Prereq: Graduate standing.* Intensive, concentrated exposure to a special educational research or evaluation problem.

Courses for Graduate Students

ResEv 615. Current Topics in Research and Evaluation. (1-0) Cr. 1; may be taken 3 times. F.S. ResEv 690. Advanced Special Topics. Cr. 1 to 3 each time taken. F.S.SS. *Prereq: Graduate standing.* Guided reading and/or study on special topics of an advanced nature.

ResEv 699. Research. Cr. arr. F.S.SS. *Prereq: Graduate standing.*

Vocational Technical Education

This specialization is planned for vocational technical educators at community colleges. Graduates will demonstrate competence in current issues and practices in community college vocational technical teaching and learning, and the role and responsibilities of teachers as leaders.

Electrical Engineering

(Administered by the Department of Electrical and Computer Engineering)

Subrahmanyam Venkata, Chair of Department

Distinguished Professors: Lord

University Professors: Jones, Wright

Professors: Anderson, Basart, Dalal, Geiger, Horton, Kothari, Jiles, Lamont, Melsa, Sheblé, Snow, Somani, S. Udpa, Venkata, Vittal, Weber

Professors (Adjunct): Hillesland, Shurtleff

Distinguished Professors (Emeritus): Brown, Nilsson, Pohm

Professors (Emeritus): Brearley, Brockman, Comstock, Fanslow, Hale, Hsieh, Koerber, Kopplin, Potter, Read, Smay, Stewart, Swift, Townsend, Triska

Associate Professors: Ajarapu, Bartlett, Black, Carlson, Chen, Davidson, Davis, Han, Hassoun, Jacobson, Khammash, Kleitsch, Kruempel, McCalley, Mohapatra, Russell, Sapatnekar, Stephenson, Tuttle, L. Udupa

Associate Professors (Emeritus): Bond, Coady, McMechan, Mericle, Pavlat, Scott

Assistant Professors: Barton, Cruz-Neira, Dickerson, Govindarasu, Lee, Patterson, Salapaka

Instructors (Adjunct): Freeman

Undergraduate Study

For undergraduate curriculum in electrical engineering leading to the degree bachelor of science, see *College of Engineering, Curricula*. This curriculum is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

Undergraduate Study

For undergraduate curriculum in electrical engineering leading to the degree bachelor of science, see *College of Engineering, Curricula*.

The Electrical and Computer Engineering (ECPE) Department at Iowa State University provides undergraduate students with the opportunity to learn electrical and computer engineering fundamentals, to study applications of the most recent advances in state-of-the-art technologies, and to prepare for the practice of engineering. The student-faculty interaction necessary to realize this opportunity occurs within an environment that is motivated by the principle that excellence in undergraduate education is enhanced by an integrated commitment to successful, long-term research and outreach programs.

The electrical engineering curriculum offers a number of specialization areas at the undergraduate level, including computer networking and security, computer architecture and digital systems, control systems, electromagnetics, microelectronics, VLSI, power systems, and communications and signal processing. An attractive feature of the curriculum is that seniors may choose among course sequences which focus on one or more of these areas; therefore graduated students have substantial depth in specific areas to complement the breadth obtained in the required curriculum.

The mission of the ECPE Programs at Iowa State University is to enable the graduated student to make significant and substantive contributions to solving engineering problems throughout the student's professional career. The following objectives are identified as critical to the accomplishment of this mission.

1. Impart and enhance knowledge in the domain of electrical and computer engineering: The graduated student should understand (a) engineering and basic science fundamentals including mathematics, probability, statis

tics, physical sciences, and information technology,

(b) the design and manufacturing processes, (c) the fundamentals of business, including entrepreneurship, engineering economy, and cost/revenue streams.

2. Expand and hone engineering abilities: The graduated student should be able to (a) identify and solve engineering problems, (b) analyze and design electrical, computer, and multidisciplinary systems, (c) design and conduct experiments and analyze resulting data, (d) use modern engineering hardware and software tools such as computer and instrumentation.

3. Instill and nurture social awareness, abilities, and understanding: The graduated student should (a) desire to engage in lifelong learning, and should expect and embrace change, (b) be able to function effectively as a member of a multidisciplinary team, to communicate effectively, and to think critically and creatively, both independently and with others, (c) apply standards of professional conduct in view of the value of science and technology in a global/societal context.

As a complement to the instruction activity, the ECPE Department provides opportunities for each student to have experience with broadening activities. Through the Cooperative Education and Internship Program, students have the opportunity to gain practical industry experience. See *College of Engineering, Cooperative Programs*. Through the Undergraduate Research Program, students have the opportunity to participate in advanced research activities; and through international exchange programs, students learn about engineering practices in other parts of the world.

Students are required to prepare and to maintain a portfolio of their technical and non-technical skills. This portfolio is evaluated for student preparation during the student's curriculum planning process. Results of the evaluation are used to advise students of core strengths and weaknesses. Prerequisite material exams are given at key points in the curriculum. These exams are to assist student evaluation of progress made during the academic experience as the material covered in several courses are the foundation of more advanced courses. These outcome assessments are also used to assess and to improve the quality of the curriculum.

Courses for students who are not in the electrical engineering program: 441, 442, 448. Credit in these courses may not be counted toward a degree in either electrical engineering or computer engineering.

Credit for only one of each of the following pairs of courses or course sequences may be counted towards graduation: E E 201, E E 202, and E E 441.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy

with major in electrical engineering and minor work to students with other majors. Minor work for electrical engineering majors is usually selected from a wide range of courses outside electrical engineering.

The degree master of science with thesis is recommended for students who intend to continue toward the doctor of philosophy degree or to undertake a career in research and development. The nonthesis master of science degree requires a creative component. Students pursuing a doctor of philosophy degree must select one of the following areas of specialization: communications and signal processing, control systems, electric power, electromagnetics, microelectronics.

The normal prerequisite to major graduate work in electrical engineering is the completion of undergraduate work substantially equivalent to that required of electrical engineering students at this university. Because of the diversification in the electrical engineering graduate program, however, it is possible for a student to qualify for graduate study in certain areas of electrical engineering even though the student's undergraduate or prior graduate training has been in a discipline other than electrical engineering. Supporting work, if required, will depend on the student's background and area of research interest. Prospective students from a discipline other than electrical engineering are required to submit, with the application for admission, a statement of the proposed area of graduate study.

The department requires submission of GRE aptitude test scores by applicants from other countries. All students whose first language is not English and who have no U.S. degree must submit TOEFL examination scores. Ph.D. students must pass a department qualifying examination.

Courses open for nonmajor graduate credit: all 300- and 400-level courses except 391, 396, 397, 398, 466, 490, 491, 492, 493, and 498.

Courses Primarily for Undergraduate Students

E E 166. Professional Programs Orientation. (1-0) Cr. R. F.S. Orientation course for students selected to the professional programs in electrical engineering and computer engineering. Overview of the nature and scope of electrical engineering and computer engineering professions. Portfolio construction. Departmental rules, advising center operations, degree requirements, program of study planning, career options, and student organizations.

E E 201. Electric Circuits. (3-2) Cr. 4. F.S. *Prereq:* Enrollment or credit in Math 267 and Phys 222. Basic circuit elements including power and energy relationships. Network theorems. Loop and nodal methods. DC, sinusoidal steady-state, and transient analysis. Operational amplifiers AC power. Introduction to state space. PSPICE. Laboratory instrumentation and experimentation.

E E 202. Circuits and Systems. (3-0) Cr. 3. F.S. *Prereq:* 201, Math 267. Balanced three-phase circuit analysis. Mutual inductance. Transformers. Circuit analysis using Laplace transforms. Transfer functions. Frequency response. Bode plots. Convolution. Fourier series with circuit applications. Two-port circuits. Basic filter concepts.

E E 213. Electromagnetics Applications in Computer Systems. (3-0) Cr. 3. F.S. *Prereq:* Phys 222, Math 265 or 270. Fundamentals of electrostatic and magnetostatic fields. Magnetization and applica-

tion to magnetic data storage media. Grounding, radio-frequency interference, noise. Electrostatic and magnetic shielding. Transmission line analysis, propagation of pulse-type signals, effects of mismatched terminations, periodic loading of lines.

E E 251. Introduction to Modern Power Systems. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in 202.* Power system structure and components. Power system operation. Types of motor loads. Dynamics of DC motors. Applications of engineering probability and statistics in electrical subsystems.

E E 264. Introduction to Space Systems and Science. (Same as Aer E 264.) (3-0) Cr. 3. *Prereq: Phys 221.* Space environment. Launch vehicles. Orbital mechanics. Spacecraft systems including communications, power, guidance, commands and data processing. Science from space including astronomy, geology, earth observing, and planetary exploration.

E E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

E E 312. Introduction to Electromagnetic Fields. (3-0) Cr. 3. F.S. *Prereq: 201, Phys 222.* Fundamentals and applications of electric and magnetic fields. Maxwell's equations, wave solutions, interaction of fields and materials, electrostatics and magnetostatics, potentials, capacitance and inductance, energy, force, torque. Introduction to numerical techniques for problems having complex geometry. Nonmajor graduate credit.

E E 313. Electromagnetic Fields and Waves. (3-0) Cr. 3. F.S. *Prereq: 202, 312.* Magnetic induction. Uniform plane electromagnetic waves; reflection and transmission at planar interfaces; Poynting vector; propagation in lossless and lossy media; dispersion. Transmission lines under transient and sinusoidal steady-state conditions. The Smith chart. Guided waves. Introductory radiation and antenna concepts. Nonmajor graduate credit.

E E 321. Continuous Signals and Systems. (3-0) Cr. 3. F.S. *Prereq: 202, credit or enrollment in Math 273.* Classification of signals and systems; basic signal manipulation and system properties; time domain analysis of continuous time LTI systems; Laplace Transform and its use in LTI system analysis; transfer functions and feedback; frequency response and analog filters; Fourier Series representation and properties; continuous time Fourier Transform; spectral analysis and AM modulation; state space analysis. Nonmajor graduate credit.

E E 324. Discrete Signals and Systems. (3-0) Cr. 3. F.S. *Prereq: 321.* Examples of discrete time signals and systems; time domain analysis of discrete time LTI systems; Z-Transform analysis of LTI systems; transfer functions and stability; discrete time system frequency response and digital filters; discrete time Fourier Series; discrete time Fourier Transform and DFT; sampling and sampling theorem; communication systems; amplitude and frequency modulation and demodulation; time and frequency division multiplexing. Nonmajor graduate credit.

E E 332. Semiconductor Materials and Devices. (Same as Mat E 332) (3-0) Cr. 3. S. *Prereq: Mat E 231 or E E 333 and credit or enrollment in E E 312 or Phys 222.* Introduction to semiconductor material and device physics. Quantum mechanics and band theory of semiconductors. Charge carrier distributions, generation/recombination, transport properties. Physical and electrical properties and fabrication of semiconductor devices such as MOSFETs, bipolar transistors, laser diodes and LED's. Nonmajor graduate credit.

E E 333. Electronic Devices and Circuits. (3-3) Cr. 4. F.S. *Prereq: 201, Cpr E 210.* Operational amplifier models and applications. DC, large-signal, and small-signal frequency-independent and frequency-dependent models and characteristics for diodes, bipolar-junction transistors, and field-effect transistors. SPICE simulation applied to electronic circuit analysis and design. IC technology for MOS and bipolar circuit

design. Characteristics of IC logic families. Laboratory design projects. Nonmajor graduate credit.

E E 391. The Engineering Professional. (1-0) Cr. 1. F.S. *Prereq: Junior classification.* Portfolio evolution and evaluation. Selected topics of interest to the engineering professional such as independent consulting, ethics, professional liability, intellectual property, business plans, venture capital, product licensing, products liability, contracts, paper and proposal writing and publishing, and teamwork. Nonmajor graduate credit.

E E 396. Summer Internship for International Students. Cr. R. SS. *Prereq: Permission of department.* Summer professional work period for international students.

E E 397. Engineering Internship. Cr. R. F.S. *Prereq: Permission of department chair.* One semester maximum per academic year professional work period.

E E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department chair; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

E E 408. Interdisciplinary Problem Solving. (Same as BusAd 408, I E 408, I Tec 408.) (3-0) Cr. 3. F.S. *Prereq: Junior or senior standing.* Use the Theory of Constraints as a way of approaching problem solving, win-win negotiation, project planning and effective delegation in the context of engineering/business systems. Team projects are aimed at improving design outcomes. Nonmajor graduate credit.

E E 409. Interdisciplinary Systems Effectiveness. (Same as BusAd 409, I E 409, I Tec 409.) (3-0) Cr. 3. F.S. *Prereq: Junior or senior standing.* Focus on functions that determine the effectiveness of an entire organization. Generic Theory of Constraints solutions to production, distribution, project management are compared to traditional solutions. Strategy for improvements discovered using simulations and group projects. Nonmajor graduate credit.

E E 414. Microwave Engineering. (Dual-listed with 514.) (3-3) Cr. 4. F. *Prereq: 333, 312.* Principles, analyses, and instrumentation used in the microwave portion of the electromagnetic spectrum. Wave theory in relation to circuit parameters. S parameters, couplers, discontinuities, and microwave device equivalent circuits. RF amplifier design, microwave sources, optimum noise figure and maximum power designs. Microwave filters and oscillators. Nonmajor graduate credit.

E E 417. Electromagnetic Radiation, Antennas, and Propagation. (Dual-listed with 517.) (3-3) Cr. 4. S. *Prereq: 313.* Wave polarization. Fundamental antenna concepts. Radiation from wire-and aperture-type sources. Radio transmission formulas. Antenna arrays. Modern antenna topics. Practical antenna design. Antenna noise. Radiowave propagation in the presence of the earth and its atmosphere. Antenna measurements and computer aided analysis. Nonmajor graduate credit.

E E 421. Communication Systems I. (3-0) Cr. 3. S. *Prereq: 324.* Frequency domain analysis. Spectral filtering. Linear modulation: signals, receivers, transmitters. Angle modulation systems. Sampling theorem and sampling practice. Frequency division multiplex. Calculation of signal-to-noise ratios. System comparisons. Nonmajor graduate credit.

E E 422. Communication Systems II. (3-0) Cr. 3. F. *Prereq: 421 and enrollment in 423.* Pulse modulation systems. Noise analysis. Quantization and pulse-code modulation. Time division multiplex. Information theory, coding. Data transmission: spectral shaping, transmission impairments, error rates. Comparison and evaluation of modulation schemes for data transmission. Nonmajor graduate credit.

E E 423. Communication Systems Laboratory. (0-3) Cr. 1. F. *Prereq: 421, enrollment in 422.* Construction and evaluation of modulators, demodulators, modems, and other components for analog and digital communications. Design and evaluate baseband communications. Noise measurement. Design and construction of a communication circuit. Nonmajor graduate credit.

E E 424. Introduction to Digital Signal Processing. (3-3) Cr. 4. S. *Prereq: 324.* Discrete time linear systems. Z-transforms. Sampling. Discrete Fourier transform. Linear and circular convolution using the DFT. Decimation and interpolation. Fast Fourier algorithms. Design of IIR and FIR filters. Realization of discrete time systems and computational complexity. Quantization effects in digital signal processing. Simulation and real-time laboratory experiments illustrating DSP principles and applications. Nonmajor graduate credit.

E E 431. Introduction to Microelectronics Fabrication. (Same as Mat E 431.) (2-4) Cr. 4. Semester: varies. *Prereq: E E 332 or Mat E 332.* An introduction to microelectronic device fabrication with hands-on laboratory experience. Students design, fabricate, and evaluate basic semiconductor materials and devices. Electronic materials processing techniques, deposition and growth, etching and photolithography, are emphasized. Materials concerns such as electron migration, contacting, film stress, barrier properties and dielectric quality are also covered. Materials fee. Nonmajor graduate credit.

E E 434. Analog Integrated Circuits I. (3-3) Cr. 4. F. *Prereq: 333.* Analog VLSI circuit design. Semiconductor processes and fabrication. Device models, simulation and CAD tools. Analog building blocks. Opamp and comparator design, voltage references and noise analysis. Nonmajor graduate credit.

E E 435. Analog Integrated Circuits II. (3-3) Cr. 4. S. *Prereq: 434.* Switched-capacitor circuits and filters, Nyquist-rate D/A and A/D converters, over-sampling data converters, integrated continuous time filters, phase-locked loop. Nonmajor graduate credit.

E E 436. Digital Integrated Circuits. (3-3) Cr. 4. F.S. *Prereq: 333.* Medium- and large- scale integrated circuits. Integrated circuit memories: comparison of various technological constraints, and memory-system design. Displays, analog switches, A/D and D/A. Design and implementation of digital logic systems and interfaces. Design laboratory. Nonmajor graduate credit.

E E 438. Optoelectronic Devices and Applications. (3-0) Cr. 3. F. *Prereq: 313, 332.* Modulation of light, display devices, light-emitting diodes, LASER operating principles and applications, photo-detectors, solar cells, optoelectronic modulation and switching devices, fiber optical waveguides, non-communication applications of fibers, miscellaneous applications of optoelectronics, introduction to optoelectronic integrated circuits. Nonmajor graduate credit.

E E 441. Introduction to Circuits, Instruments, and Electronics. (3-2) Cr. 4. F.S.SS. *Prereq: Phys 222, Math 266 or 267.* Circuit analysis using network theorems and Laplace transform techniques. Transient and sinusoidal steady-state circuit behavior. Diode circuits. Transistor amplifiers. Operational amplifiers. Other selected topics. Nonmajor graduate credit.

E E 442. Introduction to Circuits and Instruments. (3-3) Cr. 2. Half-semester course. F.S.SS. *Prereq: Phys 222, Math 267.* Basic circuit analysis using network theorems with time domain and Laplace transform techniques for resistive, resistive-inductive, resistive-capacitive, and resistive-inductive-capacitive circuits. Transient circuit behavior. Basic operational amplifiers and applications. Familiarization with common E E instrumentation and demonstration of basic principles. Nonmajor graduate credit.

E E 448. Introduction to AC Circuits and Motors. (3-2) Cr. 2. Half-semester course. F.S. *Prereq: 202 or 441 or 442.* Magnetic circuits. Power transformers. AC steady state and three-phase circuit analysis. Basic principles of operation and control of induction and single-phase motors. Nonmajor graduate credit.

E E 452. Electrical Machines and Power Electronic Drives. (2-3) Cr. 3. S. *Prereq: 251.* Basic concepts of electromagnetic energy conversion. D.C. motors and three-phase induction motors. Basic introduction to power electronics. Adjustable speed drives used for control of D.C., induction, and AC motors. Experiments with D.C. motors, A.C. motors and adjustable speed drives. Nonmajor graduate credit.

E E 455. Introduction to Energy Distribution Systems. (3-0) Cr. 3. *Prereq:* 251. Overhead and underground distribution system descriptions and characteristics, load descriptions and characteristics, overhead line and underground cable models, distribution transformers, power flow and fault analysis, overcurrent protection, power factor correction, system planning and automation, and economics in a deregulated environment. Nonmajor graduate credit.

E E 456. Power System Analysis I. (3-0) Cr. 3. F. *Prereq:* 251. Power transmission lines and transformers, network analysis, power system representation, load flow. Power system operation including the new utility environment. Nonmajor graduate credit.

E E 457. Power System Analysis II. (3-0) Cr. 3. S. *Prereq:* 251. Power system protection, symmetrical components, faults, stability. Nonmajor graduate credit.

E E 465. VLSI: Basic Layout and Design. (Same as Cpr E 465.) (3-3) Cr. 4. F. *Prereq:* 333, Cpr E 211. An introduction to CMOS VLSI layout and circuit design methodologies for custom VLSI high level synthesis of digital VLSI systems. This includes layout design rules, logic implementation techniques, timing analysis, power consumption and scaling. Different CMOS design styles are covered including static, dynamic, omimo and pseudo-NMOS. This lab includes custom VLSI, standard cell and high level synthesis design and implementation experiments. A VLSI chip design hardware project is required. Nonmajor graduate credit.

E E 466. Multidisciplinary Engineering Design. (Same as A E 466, Cpr E 466, E Sci 466, I E 466, M E 466, Mat E 466.) (1-4) Cr. 3. F. S. *Prereq:* Student must be within two semesters of graduation and receive permission of instructor. Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing, and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations and computer models and engineering drawings.

E E 475. Automatic Control Systems. (3-0) Cr. 3. S. *Prereq:* 321. Design of linear continuous and discrete control systems using root locus and frequency response methods. Analysis using modern system simulation languages. Lead and lag compensation. Rate and state variable feedback. Design projects. Nonmajor graduate credit.

E E 476. Control System Simulation. (2-3) Cr. 3. F. *Prereq:* 475. Computer aided techniques for feedback control system design, simulation, and implementation. Nonmajor graduate credit.

E E 490. Independent Study. Cr. arr. *Prereq:* Senior classification in electrical engineering. Investigation of an approved topic commensurate with the student's prerequisites.
H. Honors

E E 491. Senior Design Project I. (Same as Cpr E 491.) (1-3) Cr. 2. F.S. *Prereq:* 251 or Cpr E 308. completion of 29 credits in the E E or Cpr E core professional program, Engl 314. First semester of a team design project experience. Emphasis on defining and planning to achieve project objectives that meet a client's need. Technical writing of project plan and design review; project poster.

E E 492. Senior Design Project II. (Same as Cpr E 492.) (1-3) Cr. 2. F.S. *Prereq:* 491 or Cpr E 491. Second semester of a team design project experience. Emphasis on achieving project objectives as defined in Cpr E 491 or E E 491. Technical writing of final project report; oral presentation of project achievements.

E E 493. Portfolio Assessment. (1-0) Cr. R. *Prereq:* 391. Portfolio update and evaluation. Interviewing skills with portfolios.

E E 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of department chair; senior classification. Required of all cooperative education stu-

dents. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

E E 501. Analog VLSI Circuit Design. (Same as Cpr E 501.) (3-3) Cr. 4. F. *Prereq:* 434 or 465. Design techniques for analog and mixed-signal VLSI circuits. Amplifiers: operational amplifiers, transconductance amplifiers, finite gain amplifiers and current amplifiers. Linear building blocks; differential amplifiers, current mirrors, references, cascoding and buffering. Performance characterization of linear integrated circuits; offset, noise, sensitivity and stability. Layout considerations, simulation, yield and modeling for high-performance linear integrated circuits.

E E 505. CMOS and BiCMOS Data Conversion Circuits. (Same as Cpr E 505.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 434 and 465 or 501 Theory, design and applications of CMOS and BiCMOS data conversion circuits (A/D and D/A converters) including: quantization effects, conversion algorithms, sample and holds, element matching, comparators, voltage references and detailed implementation issues.

E E 509. Interdisciplinary Systems Thinking. (Same as BusAd 509, I Tec 509.) (3-0) Cr. 3. F.S. *Prereq:* Junior or senior standing. Student does extensive individual project using the systematic thought processes of Theory of Constraints to solve and implement the solution to a problem in their current reality. Groups scrutinize and improve each other's work.

E E 510. Topics in Electromagnetics. Cr. 1 to 3 each time elected.

E E 511. Modern Optical Communications. (3-0) Cr. 3. S. *Prereq:* 313. Propagation in optical media. Optical fibers. Optical sources and detectors. Fiber optic communications systems.

E E 512. Advanced Electromagnetic Field Theory I. (3-0) Cr. 3. F. *Prereq:* 313. Static electric and magnetic fields. Solutions of static field problems. Maxwell's equations. Circuit concepts and impedance elements. Propagation and reflection of plane waves in isotropic media. Guided electromagnetic waves. Characteristics of common waveguides and transmission lines. Propagation in anisotropic media.

E E 513. Advanced Electromagnetic Field Theory II. (3-0) Cr. 3. S. *Prereq:* 512. Special theorems and concepts. Plane wave functions. Cylindrical wave functions. Spherical wave functions. Perturbational and variational techniques.

E E 514. Microwave Engineering. (Dual-listed with 414.) (3-3) Cr. 4. F. *Prereq:* 333, 312. Principles, analyses, and instrumentation used in the microwave portion of the electromagnetic spectrum. Wave theory in relation to circuit parameters. S parameters, couplers, discontinuities, and microwave device equivalent circuits. RF amplifier design, microwave sources, optimum noise figure and maximum power designs. Microwave filters and oscillators.

E E 515. Physical Processes in Plasma. (Same as Phys 515.) (3-0) Cr. 3. *Prereq:* 313 or Phys 365. General properties of plasmas. Charged particle motion in electric and magnetic fields. Plasma kinetic theory. Macroscopic transport equations. Plasma conductivity and diffusion. Magnetohydrodynamic waves. Waves in cold, warm, and hot plasmas. Boltzmann and Fokker-Planck equations.

E E 517. Electromagnetic Radiation, Antennas, and Propagation. (Dual-listed with 417.) (3-3) Cr. 4. S. *Prereq:* 313. Wave polarization. Fundamental antenna concepts. Radiation from wire-and aperture-type sources. Radio transmission formulas. Antenna arrays. Modern antenna topics. Practical antenna design. Antenna noise. Radiowave propagation in the presence of the earth and its atmosphere. Antenna measurements and computer-aided analysis.

E E 518. Radio Astronomy and Astrophysics. (Same as Astro 518.) (3-0) Cr. 3. Alt. S. offered 2000. *Prereq:* 313 or Phys 365. Radio astronomy fundamentals. Wave polarization and measurement. Radio telescope receivers and antennas. Wave propagation

in plasmas. Synchrotron emission. Continuum and line spectra. Physical conditions in radio sources.

E E 519. Magnetism and Magnetic Materials. (Same as M S E 519.) (3-0) Cr. 3. Alt. F. offered 1999. *Prereq:* 313 or Math E 211 or 271 or 272 or Phys 364. Magnetic fields, flux density and magnetization. Magnetic materials, magnetic measurements. Magnetic properties of materials. Domains, domain walls, domain processes, magnetization curves and hysteresis. Types of magnetic order, magnetic phases and critical phenomena. Magnetic moments of electrons, theory of electron magnetism. Technological application, soft magnetic materials for electromagnets, hard magnetic materials, permanent magnets, magnetic recording technology, magnetic measurements of properties for materials evaluation.

E E 520. Selected Topics in Communications. (3-0) Cr. 3 each time elected. F. Course topics may include: information theory and coding, spread spectrum systems, satellite systems, radio navigation systems, and electric countermeasures.

E E 521. Advanced Communications Systems I. (3-0) Cr. 3. F. *Prereq:* 422. Advanced digital communication fundamentals and applications. Elements of a digital communications system. Characterization of communication signals and systems. Signals and spectra. Information theory basics. Formatting and baseband transmission. Bandpass modulation and demodulation. Communication link analysis. Source coding. Channel coding. Carrier and symbol synchronization. Optimum receivers for the additive white Gaussian noise channel. Block and convolutional channel codes. Encryption and decryption.

E E 522. Advanced Communication Systems II. (3-0) Cr. 3. S. *Prereq:* 422. Signal design for band-limited channels. Channel equalization. Multichannel and multicarrier systems. Spread spectrum signals for digital communications. Advanced digital signaling techniques. Digital communication through fading multipath channels. Multiuser communications.

E E 524. Digital Signal Processing. (3-0) Cr. 3. F.S. *Prereq:* 424, Stat 333. Spectral estimation. Linear prediction: Levinson recursion, lattice structure. Hilbert transform. Homomorphic signal processing. Multirate signal processing. Introduction to adaptive signal processing. Design of IIR and FIR digital filters using error minimization techniques. Time-frequency distributions. Statistical signal processing. Computer algorithms and applications of digital signal processing techniques.

E E 525. Speech Processing. (3-0) Cr. 3. *Prereq:* 424 or 524. Fundamentals of speech generation and perception. Linear prediction theory and concepts of pattern recognition. Speech coding: pulse code modulation, differential pulse code modulation, vector quantization, sub-band coding, transform coding. Speech vocoders. Speech recognition: dynamic time warping, hidden Markov models, neural networks. Speaker recognition. Speech synthesis. Speech enhancement.

E E 527. Statistical Communication Theory. (3-0) Cr. 3. *Prereq:* 422. Detection of signals in noise and estimation of signal parameters. Probability. Random processes. Narrowband signals. Gaussian derived processes. Hypothesis testing. Detection of known signals. Detection of signals with random parameters. Multiple pulse detection of signals. Detection of signals in colored Gaussian noise. Estimation of signal parameters. Fast Fourier transform processing. Computer problems. Applications.

E E 528. Digital Image Processing. (3-0) Cr. 3. S. *Prereq:* 524. Image fundamentals. Image transforms—Fourier, cosine, Karhunen-Loeve. Stochastic models. Enhancement—histogram equalization, smoothing, sharpening. Restoration—Wiener filter, least-squares filter, maximum entropy. Coding-error free, predictive, transform. Edge detection; image compression. Reconstruction-Radon transform, back projection, deconvolution.

E E 529. Selected Topics in Signal and Image Processing. (3-0) Cr. 3 each time selected. *Prereq:* 524. Advanced topics of current interest in the area of signal and image processing theory.

E E 530. Selected Topics in Electronics, Microelectronics and Photonics. (3-0) Cr. 3 each time elected. *Prereq:* 332.

E E 531. Semiconductor Device Design and Analysis. (3-0) Cr. 3. *Prereq:* 332. Semiconductor properties and measurement techniques. Silicon bipolar, MOS, and III-V device fabrication principles. Theory and technology of photolithography, diffusion, oxidation, plasma processing, ion implantation, epitaxial growth, chemical vapor deposition, molecular beam epitaxy, sputtering, and metallization. Use of SUPREM for fabrication process flow modeling.

E E 532. Fabrication and Characterization of Semiconductor Devices. (1-4) Cr. 3. *Prereq:* 431 or 531. Advanced silicon device processing, III-V compound device processing, epitaxial growth for silicon and III-V compounds, plasma processing, reactive ion etching, processing for optoelectronic devices. Advanced electronic and optical characterization techniques for materials and devices. Laboratory experiments.

E E 535. Physics of Semiconductors. (Same as Phys 535.) (3-0) Cr. 3. *Prereq:* 312 and 332. Basic elements of quantum theory, Fermi statistics, motion of electrons in periodic structures, crystal structure, energy bands, equilibrium carrier concentration and doping, excess carriers and recombination, carrier transport at low and high fields, phonons, optical properties, amorphous semiconductors, heterostructures, and surface effects.

E E 536. Physics of Semiconductor Devices. (Same as Phys 536.) (3-0) Cr. 3. *Prereq:* 535. P-n junctions, band-bending theory, tunneling phenomena, Schottky barriers, heterojunctions, bipolar transistors, field-effect transistors, negative-resistance devices and optoelectronic devices.

E E 539. Electronic Properties of Materials. (Same as M S E 539.) (3-0) Cr. 3. *Prereq:* 332 or Mat E 331 or Phys 322. Continuum model of materials, definition of physical properties. Electron theory, free electron model of conduction electrons, quantum corrections, internal potential and bound electrons. Electronic properties of metals, Brillouin zones, Fermi surface. Semiconductors, conduction and valence bands. Electrical, thermal, optical, and magnetic properties of materials. Technological applications, microelectronics and semiconductors, optoelectronics, superconductivity, magnetic recording technology. Electronic materials for transducers.

E E 545. Artificial Neural Networks. (3-0) Cr. 3. F. *Prereq:* 324. Introduction to the fundamentals of artificial neural networks (ANNs). Theory as well as practical implementation of networks. Topics include uses of ANNs for pattern recognition and function approximation, relation of ANNs to biological neurons, activation functions, architectures, supervised and unsupervised learning. Networks investigated typically include single and multilayer perceptrons, backpropagation, conjugate-gradient, and stochastic-based learning algorithms; radial basis networks, genetic algorithms; self-organizing networks; Kohonen's networks, Hopfield and Hamming networks and other associative networks; morphological neural networks.

E E 546. Satellite Remote Sensing. (3-0) Cr. 3. S. *Prereq:* Phys 322. Instrumentation including antennas, infrared detectors, radiometers, and spectrometers. Radiative transfer theory. Electromagnetic waves and scattering. Atmospheric effects on measurements. Synthetic aperture radar. Application of remote sensing to atmospheric science, geology, agriculture, oceans, snow and ice.

E E 547. Pattern Recognition. (3-0) Cr. 3. F. *Prereq:* 524. Mathematical formulation of pattern recognition problems and decision functions, statistical approach, Bayes classifier, pdf estimation, clustering algorithms (supervised and unsupervised), learning algorithms and neural networks, fuzzy recognition systems, feature selection methods, syntactic approach to pattern recognition.

E E 548. NDE Signal Processing. (3-0) Cr. 3. S. *Prereq:* 524. Introduction to NDE methods-electromagnetic, ultrasonic and radiographic, forward and inverse problems, continuous and discrete time signals, sampling, systems approach to solving forward

and inverse problems, deconvolution procedures and Weiner filtering. Tomographic reconstruction algorithms, signal classification algorithms, supervised and unsupervised clustering, deterministic and statistical pattern recognition, feature extraction methods.

E E 551. Operation and Control of Power Systems. (3-0) Cr. 3. *Prereq:* 456, 457. Advanced power system operating functions, economic dispatch, unit commitment, production costing, automatic generation control, dispatch of power and reactive power, state estimation.

E E 553. Steady State Analysis. (4-0) Cr. 4. F. *Prereq:* 456, 457. Power flow, economic dispatch, unit commitment, automatic generation control, sparse matrix techniques, interconnected operation, voltage control.

E E 554. Power System Dynamics. (4-0) Cr. 4. S. *Prereq:* 456, 457, 475. Dynamic performance of power systems with emphasis on stability. Modeling of system components and control equipment. Analysis of the dynamic behavior of the system in response to small and large disturbances.

E E 555. Advanced Energy Distribution Systems. (3-0) Cr. 3. *Prereq:* 455. Transient models of distribution components, automated system planning and distribution automation, surge protection, reliability, power quality, power electronics and intelligent systems applications.

E E 558. The Transient Energy Function Method. (3-0) Cr. 3. *Prereq:* 456, 457. Power system transient stability using the transient energy function (TEF) method. Behavior of generators following a large disturbance. State-of-the-art of the TEF method: theory, tools of analysis, and applications to power system problems.

E E 565. Systems Engineering and Analysis. (Same as Aer E 565, I E 565.) (3-0) Cr. 3. F. *Prereq:* Graduate classification in engineering. Introduction to organized multidisciplinary approach to designing and developing systems. Concepts, principles, and practice of systems engineering as applied to large integrated avionics systems. Life-cycle costing, scheduling, risk management, functional analysis, conceptual and detail design, test, evaluation and production.

E E 566. Avionics Systems Engineering. (Same as Aer E 566.) (3-0) Cr. 3. S. *Prereq:* 565. Avionics functions. Applications of systems engineering principles to avionics. Top down design of avionics systems. Automated design tools.

E E 570. Systems Engineering Analysis and Design. (3-0) Cr. 3. *Prereq:* 475, 577. Applications of selected topics in abstract algebra, linear algebra, theory of measure and integration, functional analysis, and optimization methods in robust and uniformly optimal control theory.

E E 573. Random Signal Analysis and Kalman Filtering. (Same as Aer E 573, Math 573, M E 573.) (3-0) Cr. 3. S. *Prereq:* 321 or Aer E 331 or M E 370 or 411 or Math 341 or 395. Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

E E 574. Optimal Control. (Same as Aer E 574, Math 574, M E 574.) (3-0) Cr. 3. S. *Prereq:* 577. The optimal control problem. Variational approach. Pontryagin's principle, Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

E E 575. Introduction to Robust Control. (Same as Math 575, Aer E 575, M E 575.) (3-0) Cr. 3. *Prereq:* 577. Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H_2 , H_∞ , and I_1 control problems. Tools for robustness analysis and synthesis.

E E 576. Digital Feedback Control Systems. (Same as Aer E 576, Math 576, M E 576.) (3-0) Cr. 3. F.

Prereq: 475 or Aer E 432 or M E 411 or 414 or Math 415; and Math 267. Sampled data, discrete data, and the z-transform. Design of digital control systems using transform methods: root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

E E 577. Modern Control Systems I. (Same as Aer E 577, Math 577, M E 577.) (3-0) Cr. 3. F. *Prereq:* 321 or Aer E 331 or M E 414 or Math 415; and Math 307. State variable and input-output descriptions of linear continuous-time and discrete-time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems. Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical form dynamical equations. State feedback. State estimators. Decoupling by state feedback. Design of feedback systems. Stability of linear dynamical systems.

E E 578. Modern Control Systems II. (Same as Aer E 578, Math 578, M E 578.) (3-0) Cr. 3. S. *Prereq:* 577. Well-posedness of nonlinear control systems. Approximate analysis methods. Poincaré perturbation method and describing function method. Lyapunov stability theory. Absolute stability of feedback systems. Input-output stability. Large-scale systems.

E E 579. Adaptive Control. (Same as Math 579, Aer E 579, M E 579.) (3-0) Cr. 3. *Prereq:* 577. Fundamentals of adaptive control: terminology, parameter identification, basic adaptive controller design techniques, analysis of stability, parameter convergence, and robustness. Nonlinear adaptive control. Application examples.

E E 590. Special Topics. Cr. 1 to 6 each time elected. Formulation and solution of theoretical or practical problems in electrical engineering.

- A. Electromagnetic Theory
- B. Control Systems
- C. Communication Systems
- D. Circuit Theory
- E. Computer Engineering
- F. Electric Power
- G. Electrical Materials
- H. Electronic Devices and Circuits

E E 591. Seminar in Electronics, Microelectronics, and Photonics. Cr. 1 to 3 each time taken.

E E 594. Seminar in Electric Power. Cr. 1 to 3 each time elected.

E E 595. Seminar in Electromagnetics. Cr. 1 to 3 each time elected.

E E 596. Seminar in Control Systems. Cr. 1 to 3 each time elected.

E E 597. Seminar in Communications and Signal Processing. Cr. 1 to 3 each time elected.

E E 599. Creative Component. Cr. var.

Courses for Graduate Students

E E 610. Advanced Topics in Electromagnetics. Cr. 1 to 3 each time elected.

E E 620. Error Detection and Correction. (3-0) Cr. 3. *Prereq:* 527 or Cpr E 584. Mathematical foundation of error detection and correction. Shift registers and pseudorandom sequences. Group codes, cyclic codes. Implementation of error detection and correction in digital systems.

E E 628. Computer Vision. (3-0) Cr. 3. F. *Prereq:* 528. Image understanding/computer vision techniques. Image-to-image and high-level image-to-representation transformations are used to provide explicit, meaningful descriptions of objects in images at various levels of abstraction. Image algebra. Segmentation techniques: boundary, region, texture. Geometrical descriptions: Euler numbers, connectivity. Relational descriptors: scene labeling, string grammars, similarity measures. Color image processing.

E E 632. Semiconductor Physics. (Same as Phys 632.) See *Physics*.

E E 653. Advanced Topics in Electric Power System Engineering. (3-0) Cr. 3 each time elected. *Prereq: Permission of instructor.* Advanced topics of current interest in electric power system engineering.

E E 674. Advanced Topics in Systems Engineering. (3-0) Cr. 3 each time elected. *Prereq: Permission of instructor.* Advanced topics of current interest in the areas of control theory, circuit theory, stochastic processes, digital signal processing, and image processing.

E E 699. Research. Cr. var.

Engineering

Loren W. Zachary, Assistant Dean for Undergraduate Programs

Professors (Emeritus): Mashaw, Sanders

Associate Professors: Dowling

Most of the courses with the designator of *Engr* are broad-based engineering courses applicable to all engineering disciplines. Several of these courses are part of the basic program which is required for engineering students. Course-related questions should be directed to the department or unit with responsibility for that course. The following is a list of those responsibilities:

Engr 101 Engineering Student Services

Engr 110 Engineering Computing Support Services

Engr 160 Materials Science and Engineering

Engr 161 Electrical and Computer Engineering

Engr 170 Aerospace Engineering and Engineering Mechanics

Courses Primarily for Undergraduate Students

Engr 101. Engineering Orientation. (1-0) Cr. R. F.S. Introduction to the College of Engineering and the engineering profession. Considerations in choosing an engineering curriculum. Information concerning university and college policies, procedures, and resources. Opportunities to interact with departments.

Engr 104. LEAD Program Orientation. (1-0) Cr. 1. F. Orientation for LEAD Program participants. Applications of problem solving, engineering design, teamwork, study, and time management techniques and skills. Engineering professional development.

Engr 110. Engineering Orientation to Computing Facilities. (1-0) Cr. R. F. An introduction to computing facilities available to engineering students at Iowa State University. Procedures for accessing and utilizing useful software in the personal computer labs and on the Vincent system. Instruction in navigating the Iowa State backbone network and the internet system.

Engr 160. Engineering Problems with Computational Laboratory in FORTRAN. (2-2) Cr. 3. F.S.SS. *Prereq: Math 141, 142 or satisfactory scores on mathematics placement examinations; credit or enrollment in Math 165.* Solving engineering problems and presenting solutions through technical reports. Graphing and curve-fitting. Use of SI units. Significant figures. Flowcharting. Introduction to engineering economics and statistics. Solution of engineering problems using the FORTRAN language. The honors section includes applications of programming to mobile robotics.
H. Honors. F.

Engr 161. Engineering Problems with Computational Laboratory in C. (2-2) Cr. 3. F.S.SS. *Prereq: Math 141, 142 or satisfactory scores on mathematics placement examinations; credit or enrollment in Math 165.* Solving engineering problems and presenting solutions through technical reports. Graphing and curve-fitting. Use of SI units. Significant figures. Introduction to engineering economics and statistics. Solution of engineering problems using the C language.
H. Honors. F.

Engr 170. Engineering Graphics and Introductory Design. (2-4) Cr. 3. F.S.SS. *Prereq: Math 141, 142 or satisfactory scores on mathematics placement examinations; credit or enrollment in Math 165.* Integration of fundamental graphics, computer modeling, and engineering design. Applications of multi-view drawings and dimensioning. Techniques for visualizing, analyzing, and communicating 3-D geometries. Application of the design process including written and oral reports. Freehand and computer methods.
H. Honors. S.

Engineering Mechanics

(Administered by the Department of Aerospace Engineering and Engineering Mechanics)

Thomas J. Rudolph, Chair of Department
Distinguished Professors: R. B. Thompson, Young

Professors: Chimenti, Greer, Holger, Inger, Jenison, Jischke, McConnell, McDaniel, Munson, Pierson, Rizzo, Rogge, Rohach, Rothmayer, Rudolph, Schmerr, Tannehill, Tsai, Wilson, Zachary

Professors (Adjunct): Hsu

Professors (Collaborators): Alers, Fortunko
Distinguished Professors (Emeritus): Riley, D. Thompson

Professors (Emeritus): Akers, Iversen, Weiss

Associate Professors: Dayal, Flatau, Hilliard, Hindman, Lu, Mann, Mitra, Rajagopalan, Sherman, Sturges, Vogel

Associate Professors (Adjunct): Roberts, Trulin

Associate Professors (Emeritus): Hermann, James, Seversike

Assistant Professors: Jacobson, Liljegren, Scheeres

Assistant Professors (Adjunct): Gray, Kellogg, Legg

Undergraduate Study

The courses in mechanics are intermediate between those in physics and mathematics and the professional and design courses of the several engineering curricula. In the work of this department the student is expected to acquire an understanding of the principles underlying the technique of analysis and a knowledge of those properties of materials which influence the manner and extent of their use for engineering purposes. Physical properties of engineering materials are studied in the classroom and are evaluated in the laboratory. General laws, such as those of

Newton, are given mathematical expression and are made suitable for use in the solution of specific problems in machine and structural design, and in the flow and measurement of fluids.

Graduate Study

The department offers work for the degrees master of science, master of engineering, and doctor of philosophy with major in engineering mechanics, and minor work to students taking major work in other departments.

The master of science degree requires a thesis and a minimum of 8 research credits. It has strong research emphasis and is recommended for students who anticipate entering a doctoral program later. At least 30 credits of acceptable graduate work are required for the degree.

The master of engineering degree does not require either research credits or a thesis. However, at least two credits of acceptable creative component and at least 26 credits of acceptable graduate coursework are required. A minimum of 30 credits of acceptable graduate work is required for the degree. The program is intended to give students additional instruction at the graduate level to better qualify them for advanced professional engineering work. By careful selection of electives and perhaps additional courses during the senior undergraduate year, students should be able to qualify for the master of engineering degree with an additional year of full-time study after receiving their baccalaureate degree in one of the several engineering curricula.

Credits for creative component will be obtained by registering for E M 599. A written report and an oral presentation will be given to the student's graduate committee.

The normal prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this university. However, because of the diversity of interests in graduate work in engineering mechanics, it is possible for a student to qualify for graduate study even though undergraduate or prior graduate training has been in a discipline other than engineering—e.g., physics or mathematics.

Cooperative programs between Engineering Mechanics and Biomedical Engineering are provided jointly under the sponsorship of the Colleges of Engineering and Veterinary Medicine. Laboratory facilities are available both in the veterinary medicine complex and on the main campus. See *Biomedical Engineering* for requirements.

Courses open for nonmajor graduate credit: All 300- and 400-level courses except 301, 307 and 490.

Courses Primarily for Undergraduate Students

E M 274. Statics of Engineering. (3-0) Cr. 3. F.S.SS. *Prereq: Credit or enrollment in Math 166; credit or enrollment in Phys 111 or 221.* Vector and scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, second moments of areas, Mohr's circle, radius of gyration, internal forces, shear and bending moment dia-

grams. Credit for only one of the sequences (307, 324) or (274, 324, 345) may be allowed for graduation. Credit for only one of 274, 301, 307 may be allowed for graduation.

E M 301. Fundamentals of Mechanics. (4-0) Cr. 4. F.S.SS. *Prereq:* *Phys 221, Math 166.* Newton's laws, equilibrium of rigid and deformable bodies, stress. Kinematics and dynamics of particles and rigid bodies. Deformation and strain of solids and fluids, constitutive equations for solids and Newtonian fluids. Applications to tension, torsion, flexure of solid bars and vibrations. Credit for only one of 274, 301, 307 may be allowed for graduation.

E M 306. Static and Mechanics of Materials. (5-0) Cr. 5. F.S.SS. *Prereq:* *Credit or enrollment in Math 166; credit or enrollment in Phys 111 or 221.* Resultants, equilibrium of rigid and deformable bodies, centroids, second moments of inertia. Stress-strain relationships, deformation, Castigliano's Theorems. Analysis of axial, torsion, beam bending, buckling, and combined loading. Theories of failure and stress concentration factors. Credit for only one of 274, 301, 306, 307 may be allowed for graduation. No more than six credits from 274, 306, 324 may be used for graduation. Nonmajor graduate credit.

E M 307. Statics and Dynamics. (5-0) Cr. 5. F.S. *Prereq:* *Credit or enrollment in Math 166, credit or enrollment in Phys 221.* Principles of static equilibrium. Forces and moments for planar systems. Applications to planar problems in trusses, beams, and machines, centroids, second moments of areas, and friction. Dynamics of particles and rigid bodies in planar motion. Kinematics of a particle in rectilinear and curvilinear motion. Equations of motion, energy, and momentum methods for a particle. Kinematics of rigid bodies. Moments of inertia. Equations of motion, energy, and momentum methods for rigid bodies. Vibrations. Credit for only one of 274, 301, 307 may be allowed for graduation. No more than six credits from 307, 345, may be used for graduation.

E M 324. Mechanics of Materials. (3-0) Cr. 3. F.S.SS. *Prereq:* *274 or 307.* Plane stress, plane strain, stress-strain relationships, and elements of material behavior. Application of stress and deformation analysis to members subject to centric, torsional, flexural, and combined loadings. Elementary considerations of theories of failure, buckling. Nonmajor graduate credit.

E M 327. Mechanics of Materials Laboratory. (0-3) Cr. 1. F.S.SS. *Prereq:* *301 or credit or enrollment in 324.* Experimental determination of mechanical properties of selected engineering materials. Experimental verification of assumptions made in 301 and 324. Use of strain measuring devices. Preparation of reports. Students who are not present for the first laboratory meeting of their own sections may qualify for continuation in the course only by attending the first laboratory meeting of some other section of the course. Nonmajor graduate credit.

E M 336. Engineering Materials. (2-0) Cr. 2. F.S. *Prereq:* *301 or credit or enrollment in 324.* Structure, properties, and uses of engineering materials, with emphasis on construction materials. Nonmajor graduate credit.

E M 345. Dynamics. (3-0) Cr. 3. F.S.SS. *Prereq:* *274 or 301, credit or enrollment in Math 266 or 267.* Particle and rigid body kinematics, Newton's laws of motion, kinetics of plane motion, rigid body problems using work-energy, linear, and angular impulse-momentum principles, vibrations. Nonmajor graduate credit. No more than six credits from 307, 345, may be used for graduation.

E M 350. Introduction to Nondestructive Evaluation Engineering. (3-0) Cr. 3. S. *Prereq:* *301 or 324, Math 266, Phys 222.* Introduction to the fundamentals of ultrasonic, eddy current, and x-ray testing. The generation, transmission, scattering, and reception of ultrasonic waves and x-rays in an NDE inspection. Safety issues. The connection between NDE, fracture mechanics, and reliability. Probability of detection and its impact on failure. The use of NDE in design. Nonmajor graduate credit.

E M 362. Principles of Nondestructive Testing. (Same as Mat E 362.) See *Materials Engineering.* Nonmajor graduate credit.

E M 362L. Nondestructive Testing Laboratory. (Same as Mat E 362L.) See *Materials Engineering.* Nonmajor graduate credit.

E M 378. Mechanics of Fluids. (2-2) Cr. 3. F.S.SS. *Prereq:* *274 or 301 or 307.* Properties of fluids. Fluid statics. Kinematics and kinetics of fluid flow. Mass, momentum, and energy conservation laws; dimensional analysis; flow in pipes and channels. Selected laboratory experiments. Nonmajor graduate credit.

E M 417. Experimental Mechanics. (2-2) Cr. 3. F. *Prereq:* *301 or 324.* The use of strain gages and brittle coating with applications to practical engineering problems. Strain gage based transducers, recording and output devices. Selected laboratory experiments. Nonmajor graduate credit.

E M 424. Intermediate Mechanics of Materials. (3-0) Cr. 3. F.S. *Prereq:* *324.* Stresses, strains, deflections and angular twist of symmetrical and unsymmetrical members subjected to combined loading. Analysis of contact stress problems and shrink fit problems. Dynamic load effects, fatigue and fracture mechanics introduction. Stress analysis of connections. Nonmajor graduate credit.

E M 425. Introduction to the Finite Element Method. (3-0) Cr. 3. F.S. *Prereq:* *301 or 324, Math 266 or Math 267.* Introduction of finite element analysis through applications to one-dimensional, steady-state problems such as elastic deformation, heat and fluid flow, consolidation, beam bending, and mass transport. Transient heat conduction and wave propagation. Two-dimensional triangular and quadrilateral elements. Plane problems of torsion, thermal and potential flow, stress analysis. Simple computer programs for one- and two-dimensional problems. Nonmajor graduate credit.

E M 444. Mechanical Vibrations. (2-2) Cr. 3. F. *Prereq:* *324, 345.* Elementary vibration analysis, single and multiple degrees of freedom, energy methods, free and forced vibrations, viscous damping, transmissibility, matrix methods, modal analysis. Selected laboratory experiments. Numerical methods of solution. Nonmajor graduate credit.

E M 451. Engineering Acoustics. (Same as M E 451.) (2-2) Cr. 3. S. *Prereq:* *Phys 221 and Math 266 or 267.* Sound sources and propagation. Noise standards and effects of noise on people. Principles of noise and vibration control used in architectural and engineering design. Characteristics of basic noise measurement equipment. Experience in use of noise measuring equipment, sound power measurements, techniques for performing noise surveys, evaluation of various noise abatement techniques applied to common noise sources. Selected laboratory experiments. Nonmajor graduate credit.

E M 490. Independent Study. Cr. arr. *Prereq:* *Permission of instructor.*
H. Honors.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

E M 504. Analytical Methods in Mechanics. (3-0) Cr. 3. *Prereq:* *Math 385.* Applications of the equations of heat conduction, potential theory, and wave propagation to problems in mechanics. Methods of solution.

E M 505. Analytical Methods in Mechanics. (3-0) Cr. 3. *Prereq:* *504.* Applications of the equations of heat conduction, potential theory, and wave propagation to problems in mechanics. Methods of solution.

E M 510. Continuum Mechanics. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* *Math 385.* Presentation of the basic equations of engineering mechanics: conservation of mass, conservation of momentum, conservation of energy; principles of selection of constitutive equations; constitutive relations for classical elastic materials and classical fluids; simple rheological models for viscoelastic materials; introduction to Cartesian tensors.

E M 514. Advanced Mechanics of Materials. (Same as Aer E 514.) (3-0) Cr. 3. F. *Prereq:* *324.* Theory of stress and strain, stress-strain relationships. Limitations of flexure and torsion formulas, unsymmetrical bending, curved beams, cross-shear, shear center. Torsion of thin-walled noncircular sec-

tions. Theories of failure, membrane stresses in shells, thick-walled cylinders.

E M 515. Buckling. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* *514.* Stability of columns, beam-columns, bars and frames. Inelastic buckling, torsional buckling, bending and buckling of thin plates and shells.

E M 516. Applied Elasticity. (3-0) Cr. 3. S. *Prereq:* *Math 385.* Fundamentals of linear continuum elasticity theory, formulation and solutions of simple elastostatic boundary value problems. Vector and tensor analysis. Kinematics of small deformations, constitutive laws for isotropic and anisotropic media. Field equations for one-, two-, and three-dimensional solids. Formulation of plane strain/plane stress problems by stress function methods. Corresponding solutions to a variety of classic canonical problems, such as those of Bickley, Boussinesq, Hertz, Kirsch, Lamé, Melan, and Mitchell.

E M 517. Experimental Stress Analysis. (Same as Aer E 517.) (3-2) Cr. 4. Alt. S., offered 2001. *Prereq:* *324.* Fundamental concepts of stress and strain measurement, strain gage characteristics, strain gage circuits and instrumentation, strain gage based transducers, transmission and reflection photoelasticity, two- and three-dimensional photoelasticity, Moire interferometry methods of measuring displacement and strains.

E M 518. Wave Propagation in Elastic Solids. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* *Math 385.* Elastic waves are treated from both an analytical and phenomenological standpoint, with an introduction to continuum mechanics. Reflection, transmission at planar interfaces lead to study of guided waves, primarily Rayleigh, Lamb, SH, and Stoneley waves, also with fluid loading. Waves in anisotropic elastic media are covered. Acoustic source radiation, reciprocity, and diffraction and material damping are covered.

E M 519. Experimental Methods of Motion Measurement. (2-2) Cr. 3. Alt. S., offered 2000. *Prereq:* *417, 444.* Description, specifications, limitations, and applications of mechanical, electrical, and optical transducers used in motion measurements applied to steady state, transient, and shock motions. Calibration, signal conditioning, and transducer systems used to obtain reliable and reproducible experimental data. Seismic and absolute references for motion measurement.

E M 521. Biomechanics. (Same as B M E 521, I E 521.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* *Phys 111 or 221, Math 265.* For students with interests in the life sciences ergonomics, or rehabilitation engineering. Topics include motion, energy, equilibrium, stress and deformation, material properties, flow of fluids, dimensional analysis and modeling of biological systems. Illustrative examples taken from biology and medicine.

E M 522. Energy Methods in Applied Mechanics. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* *514 or 516 and Math 385.* Introduction to variational principles and energy methods in applied mechanics. Applications in solid mechanics, dynamics, and elasticity—bars, beams, torsion, and plane elasticity. Variational methods of approximation—Ritz's method, weighted residuals, finite elements. Applications in plates, shells, and components.

E M 524. Numerical Mesh Generation. (Same as Aer E 524, M E 524.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* *Math 385.* Introduction to modern mesh generation techniques. Structured and unstructured mesh methods, algebraic and PDE methods, elliptic and hyperbolic methods, variational methods, error analysis, Delaunay triangulation, data structures, geometric modeling with B-spline and NURBS surfaces, surface meshing.

E M 525. Finite Element Analysis. (Same as Aer E 525.) (3-0) Cr. 3. S. *Prereq:* *425, Math 385.* Variational and weighted residual approach to finite element equations. Emphasis on two- and three-dimensional problems in solid mechanics. Isoparametric element formulation, higher order elements, numerical integration, imposition of constraints and penalty, convergence, and other more advanced topics. Use of two- and three-dimensional computer programs. Dynamic and vibrational problems, eigenvalues, and time integration. Introduction to geometric and material nonlinearities.

E M 526. Boundary Element Methods in Engineering. (3-0) Cr. 3. Alt. S., offered 2000.

Prereq: 514 or 516. Introductory boundary element methods through plane problems. Singular integrals, Cauchy principal values, integral representations and boundary integrals in one dimension. Direct and indirect formulations. Plane potential and elastostatic problems. Higher order elements, numerical integration. Regularizations. Body forces and infinite regions. Specialized fundamental solutions, half-plane and axisymmetric problems. Diffusion and wave problems. Coupling with finite elements.

E M 544. Mechanical Vibrations. (2-2) Cr. 3. F. *Prereq:* 324, 345. Elements of lumped parameter linear systems, kinematics of vibrations, equations of motion for free and forced vibrations, energy methods, resonance, damping, multiple degrees of freedom, mechanical impedance, isolation and absorption of vibrations with impulsive and arbitrary excitation of linear systems, primary and residual shock spectra. Vibration of continuous systems.

E M 545. Vibration Testing. (2-2) Cr. 3. S. *Prereq:* 444 or 544. Theory of signal analysis, review of vibration concepts central to vibration testing, instrumentation considerations of force and acceleration measurements, digital frequency analyzer characteristics, and vibration exciter characteristics; application to overall test system-test structure interaction; requirements of transferring field data to laboratory simulation; standard test specifications. Term laboratory project.

E M 546. Introduction to Random Vibrations. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 544. Modal analysis, nonlinear vibration phenomena. Characteristics of random vibrations; random processes, probability distributions, spectral density and its significance, the normal or Gaussian random process. Transmission of random vibration, response of simple single and two-degree-of-freedom systems to stationary random excitation. Fatigue failure due to random excitation.

E M 548. Advanced Engineering Dynamics. (3-0) Cr. 3. F. *Prereq:* 345, *Math 266 or 267.* Dynamics of particles and rigid bodies. Generalized coordinates. Lagrangian equations of motion. Equations of motion in terms of Eulerian angles, motion of a gyroscope.

E M 549. Vehicle Dynamics. (Same as M E 549.) (3-0) Cr. 3. F. *Prereq:* 345, *Math 266 or 267.* Analysis and evaluation of the performance of cars and trucks. Computer simulation of ride, braking, and directional response.

E M 550. Fundamentals of Nondestructive Evaluation. (Same as M S E 550.) (3-2) Cr. 4. S. *Prereq:* 301 or 324, *Math 385.* Basic physics of ultrasonic, radiographic, and electromagnetic NDE measurements. Principles and uses of other quantitative techniques in nondestructive evaluation. Signal processing and evaluation methods. Laboratory experiments in ultrasonics, eddy current, and x-ray radiography methods of NDE.

E M 551. Signal Processing in Mechanics. (Same as M E 551.) (2-2) Cr. 3. S. *Prereq:* 444 or 451, *Math 385.* Classification and measurement of time dependent phenomena in mechanics. Correlation, spectral and probabilistic techniques for the analysis of acoustical, vibrational, and unsteady fluid dynamic phenomena. Selected laboratory experiments emphasizing dual channel FFT analyzer applications in mechanics.

E M 552. Advanced Acoustics. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 444 or 451. Theoretical acoustics: wave propagation in fluids; acoustic radiation, diffraction and scattering; and architectural acoustics. Applications of basic acoustic theory in noise control and acoustic radiation. Introduction to selected numerical methods in acoustics.

E M 555. Biomedical Fluid Mechanics. (Same as B M E 555.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 520. Applications of principles and concepts of fluid mechanics to problems in biology and medicine. Hemodynamic characteristics of the circulation, rheology of blood flow in the microcirculation, flow in the large arteries, and the respiratory system.

E M 560. Scanning Electron Microscopy Characterization of Materials. (2-2) Cr. 3. F. *Prereq:* *Mat E 272.* Principles of scanning electron

microscopy and energy dispersive X-ray microanalysis. Laboratory microstructural-microchemical analyses of materials.

E M 564. Fracture and Fatigue. (Same as M S E 564 and M E 564.) (3-0) Cr. 3. F. *Prereq:* 324 and any one of 336, *E Sci 352, Mat E 211 or 272.* Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics. Fracture and fatigue tests, thermal fracture, mechanics and materials designed to avoid fracture or fatigue.

E M 568. Plasticity and Creep of Materials. (Same as M S E 568.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 324. Mechanics and materials approach to plasticity and creep, stress and strain tensors, yield criteria, flow rules, slip-line theory, and work hardening. Axially symmetric problems, bending, thermal load, torsion. Introduction to creep deformation, stress relaxation, and recovery problems.

E M 569. Mechanics of Composite and Combined Materials. (Same as M S E 569 and Aer E 569.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 324. Mechanics of fiber-reinforced materials. Macromechanical behavior of lamina and laminates. Strength and interlaminar stresses of laminates. Failure criteria. Micromechanics of lamina. Stress analysis of laminates. Thermal and moisture stresses and residual stresses.

E M 571. Advanced Fluid Mechanics. (3-0) Cr. 3. F. *Prereq:* 378 or M E 335. Mass, momentum, and energy conservation laws of fluid dynamics; control volume and differential forms of governing equations; real and ideal fluids; concepts of stress, strain-rate, and vorticity; exact solutions of Navier-Stokes equations for steady and unsteady flows; low Reynolds number flows; boundary layer approximation; laminar and turbulent boundary layers; two-dimensional and axisymmetric potential flow problems; elements of compressible flow; engineering applications.

E M 572. Advanced Fluid Mechanics. (3-0) Cr. 3. S. *Prereq:* 571. Mass, momentum, and energy conservation laws of fluid dynamics; control volume and differential forms of governing equations; real and ideal fluids; concepts of stress, strain-rate, and vorticity; exact solutions of Navier-Stokes equations for steady and unsteady flows; low Reynolds number flows; boundary layer approximation; laminar and turbulent boundary layers; two-dimensional and axisymmetric potential flow problems; elements of compressible flow; engineering applications.

E M 574. Ultrasonic Nondestructive Measurement Principles. (Same as M S E 574.) (3-0) Cr. 3. F. *Prereq:* 370, 516, *Math 385.* Ultrasonic inspection techniques, underlying theory of elastic wave propagation and scattering. Transducer modeling and the development of a complete ultrasonic measurement model. Fundamental aspects of linear system theory. Application to flaw detection and sizing.

E M 580. Biomaterials. (Same as B M E 580 and M S E 580.) (3-0) Cr. 3. S. *Prereq:* *Mat E 211 or 272.* Presentation of the basic chemical and physical properties of biomaterials as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

E M 584. Similitude in Engineering. (2-2) Cr. 3. S. *Prereq:* 324, a fluids course. Principles of dimensional analysis and their application to design of models. Design, testing, and interpretation of true and distorted models. Similarity analysis. Analogies.

E M 590. Special Topics. Cr. 1 to 4 each time taken. *Prereq:* *Permission of instructor.*
A. Advanced Engineering Acoustics
C. Thermal Stresses in Design
D. Linear Viscoelasticity
E. Biomechanics
F. Other Topics

E M 599. Creative Component. Cr. arr.

Courses for Graduate Students

E M 645. Advanced Vibration Analysis. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 544, *Math 385.* Multiple degrees of freedom, inertia and stiffness matrices,

transfer matrices, numerical methods. Vibration of continuous systems, limitations, and comparison of lumped approximations of continuous systems. Engineering applications.

E M 648. Advanced Topics in Dynamics. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 548, *Math 385.* Topics of current interest in dynamics such as vehicle stability, modeling multicomponent dynamical systems, and nonrigid body dynamics.

E M 651. Advanced Topics in Fluid Mechanics. (Same as M E 651.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 571. Topics of current interest in fluid mechanics such as separation phenomena, three-dimensional boundary layers, unsteady flow phenomena, asymptotic methods in viscous flows, stability, theory of homogeneous isotropic turbulence, and turbulence models.

E M 690. Special Topics. Credit 1 to 6 each time taken. *Prereq:* *Permission of instructor.*
A. Advanced Experimental Mechanics
B. Nonlinear Wave Propagation
C. Nonlinear Material Behavior
D. Composite Materials
E. Holography in Mechanics
F. Finite Elements of Nonlinear Continua
G. Fracture Mechanics
H. Atmospheric Fluid Mechanics
I. Viscous Flow Theory
J. Advanced Similitude Analysis
K. Advanced Analytic Methods in Mechanics
L. Rheology
M. Other Topics

E M 699. Research.

Engineering Operations

Administered by a supervisory committee appointed by the dean of the College of Engineering. L. Zachary, chair; M. Goodwin, P. Patterson, L. Sturges, D. Trulin.

Undergraduate Study

For undergraduate curriculum in engineering operations leading to the degree bachelor of science, see *College of Engineering, Curricula.*

In this era of rapid technological change, there is an expanding need for persons with an engineering background. Engineering operations is specifically designed to develop this background by merging several engineering disciplines or by combining engineering with other disciplines. Students are able to design their program of study to specialize in non-traditional engineering fields or to combine non-technical specializations with a solid foundation in core engineering subjects. Students will be prepared for entry into their chosen field of interest or for further study at the graduate level in any of the fields in engineering or related areas of study, such as law or business.

To achieve engineering operation's program goals, the student must have:

- A strong foundation in engineering courses.
- A broad foundation in mathematics and physical sciences.
- Oral and written communication abilities to effectively communicate with technical and non-technical professionals.
- Basic skills in the use of computers for communication, engineering design and problem solving.

The program develops the ability of students to be effective communicators and develops the unique and creative talents of the students. This is achieved by:

- Allowing students to design their own program of study to align closely with their own talents and interests.
- Requiring students to design and communicate their program of study to faculty and professionals.
- Requiring course work that includes utilizing and developing communication skills.
- Providing opportunities for internships, cooperative education, study-abroad, and other meaningful employment.

Courses in the social sciences and humanities, U.S. diversity, and international perspectives are included in the curriculum to broaden the student's perspective of the global work environment. Engineering operation students are encouraged to participate in life-long learning and continuous professional development.

New students are not admitted directly into this program. Students wanting Engineering Operations may be admitted into Engineering (not a degree granting program but used for new students undecided on an engineering curriculum) or any of the degree granting programs.

Prior to entering the engineering operations program the student must have completed the basic program and have presented a description of the professional objective to be achieved through the program to the chair of the supervisory committee for approval. In addition the student must submit a schedule of courses to support this objective.

Emphasis Areas

Selected emphasis areas available in engineering operations are listed below. Students are encouraged to propose other programs to meet individual professional objectives.

A. Engineering Journalism (133.5)

Degree in engineering combined with selected courses from journalism.

B. Engineering Management (133.5)

A degree in engineering combined with a minor in business. (See *College of Business* for minor requirements.)

C. Environmental Engineering

A program to emphasize environmental applications of engineering.

D. Health Technology

Applications of engineering to health fields.

E. Officer Education

A program in cooperation with Air Force Aerospace Studies, Naval Science, and Military Science. A minor is possible in Naval Science. See *Officer Education Programs*.

F. Technical Sales

A program providing preparation for selling products of a technical nature and consulting with the manufacturer and the industrial consumer to solve engineering problems.

G. Technical Systems Administration

A program designed for those planning to enter technical administration in public agencies (e.g., city managers or county administrators).

H. Other

A program may be planned by the individual student subject to approval by the supervisory committee. Distance learning program proposals will be considered.

Courses Primarily for Undergraduate Students

E Op 298. Cooperative Education. Cr. R. F.S.SS.

Prereq: Permission of Engineering Operations Supervisory Committee Chair; sophomore classification. Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

E Op 396. Summer Internship for International Students. Cr. R. SS. *Prereq: Permission of*

Engineering Operations Supervisory Committee Chair. Summer professional work period for international students.

E Op 397. Engineering Internship. Cr. R. F.S.

Prereq: Permission of Engineering Operations Supervisory Committee Chair. One semester maximum per academic year professional work period.

E Op 398. Cooperative Education. Cr. R. F.S.SS.

Prereq: Permission of Engineering Operations Supervisory Committee Chair; junior classification. Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

E Op 498. Cooperative Education. Cr. R. F.S.SS.

Prereq: Permission of Engineering Operations Supervisory Committee Chair; senior classification. Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

Engineering Science

(Administered by the Department of Aerospace Engineering and Engineering Mechanics)

Thomas J. Rudolphi, Chair of Department

Distinguished Professors: R. B. Thompson, Young

Professors: Chimenti, Greer, Holger, Inger, Jenison, Jischke, McConnell, McDaniel, Munson, Pierson, Rizzo, Rogge, Rohach, Rothmayer, Rudolphi, Schmerr, Tannehill, Tsai, Wilson, Zachary

Professors (Adjunct): Hsu

Professors (Collaborators): Alers, Fortunko
Distinguished Professors (Emeritus): Riley, D. Thompson

Professors (Emeritus): Akers, Iversen, Weiss

Associate Professors: Dayal, Flatau, Hilliard, Hindman, Lu, Mann, Mitra, Rajagopalan, Sherman, Sturges, Vogel

Associate Professors (Adjunct): Roberts, Trulin

Associate Professors (Emeritus): Hermann, James, Seversike

Assistant Professors: Jacobson, Liljegren, Scheeres

Assistant Professors (Adjunct): Gray, Kellogg, Legg

Undergraduate Study

For the undergraduate curriculum in engineering science leading to the degree bachelor of science, see *College of Engineering, Curricula*.

This curriculum is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

Academic Program Goal: Provide an effective program that fulfills student needs and that equips and empowers qualified students for a successful career in their chosen area of specialization.

The Engineering Science Program follows all Iowa State University and College of Engineering goals and outcomes, as listed in the Iowa State University catalog.

The main objectives of the engineering science program are

- To allow students to pursue an interest in engineering that is not directly accessible through one of the traditional engineering majors.
- To prepare our students for lifelong learning.

Supporting objectives of the engineering science program are

- To ensure that our students have a strong background in the basic sciences: mathematics, physics, and chemistry.
- To ensure that our students have a broad and strong background in the engineering sciences: solid mechanics, fluid mechanics, dynamics, materials science, thermal sciences, and electrical sciences.
- To provide our students with non-textual experiences through hands-on laboratory courses, internships, and co-op experiences.

The curriculum in Engineering Science is designed for those students who wish to receive training in a particular field that is multidisciplinary. Examples are acoustics, astronautics, avionics, biomedical engineering, control systems, computational and experimental mechanics, dynamics and vibrations, and non-destructive evaluation. Twenty-one credits of technical electives provides our students the opportunity to develop expertise in their chosen field of interest.

The curriculum is well adapted as a base for those students who wish to enter the research, development, production, or design areas of engineering or who intend to pursue a graduate program. By a judicious choice of electives in the junior and senior years, it is possible to go on to attain a master of science or master of engineering degree in either two or three additional semesters beyond the bachelor's degree.

Graduate Study

Minor work is available to students taking major work in other departments.

Courses open for nonmajor graduate credit: all 300- and 400-level courses except 396, 397, 398, 466 and 498.

Courses Primarily for Undergraduate Students

E Sci 170. Engineering Graphics Fundamentals. (Same as Aer E 170.) (0-4) Cr. 2. F.S. *Prereq: Math 141, 142 or satisfactory scores on mathematics placement examinations; credit or enrollment in Math 165.* Graphical description of geometry with freehand techniques. Introduction to geometric mod

English

eling with parametric modeling software. Emphasis on visualization, multiviews, and size definition.

E Sci 298. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of department chair; sophomore classification. Required of all cooperative students. Students must register for this course prior to commencing each work period.

E Sci 351. Engineering Materials I. (3-2) Cr. 4. F. *Prereq:* E M 324. Resistance of materials to failure, definitions and evaluation of properties, relationship to design. Effects of environment on properties. Laboratory determinations. Structure of materials and influence of structure upon properties. Nonmajor graduate credit.

E Sci 352. Engineering Materials II. (3-2) Cr. 4. S. *Prereq:* 351 or Mat E 211. Thermal, magnetic, and electrical characteristics. Properties of single crystals, polycrystalline systems, aggregates of domains, thin films and amorphous solids. Interatomic forces, energy considerations. Engineering applications. Nonmajor graduate credit.

E Sci 382. Experimental Methods in Engineering Science and Mechanics. (2-2) Cr. 3. S. *Prereq:* E M 324, 345, Math 266 or 267, Stat 231, knowledge of FORTRAN. Planning, design, and construction of experiments and experimental apparatus in engineering science and mechanics. Interpretation and documentation of experimental results. Design project. Nonmajor graduate credit.

E Sci 396. Summer Internship for International Students. Cr. R. SS. *Prereq:* Permission of department. Summer professional work period for international students.

E Sci 397. Engineering Internship. Cr. R. F. S. *Prereq:* Permission of department chair. Professional work period, one semester maximum per academic year.

E Sci 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of department chair; junior classification. Required of all cooperative students. Students must register for this course prior to commencing each work period.

E Sci 466. Multidisciplinary Engineering Design. (Same as A E 466, Cpr E 466, E E 466, I E 466, M E 466, Mat E 466.) (1-4) Cr. 3. F.S. *Prereq:* Student must be within two semesters of graduation and receive permission of the instructor. Application of team design concepts to projects of a multi-disciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

E Sci 481. Senior Engineering Science and Mechanics Design Project I. (1-2) Cr. 2. F. *Prereq:* 382, Math 481. Development of design project proposal in student's area of specialty in engineering science. Nonmajor graduate credit.

E Sci 482. Senior Engineering Science and Mechanics Design Project II. (1-6) Cr. 4. S. *Prereq:* 481. Continuation of student's design project. Formal oral and written presentation. Nonmajor graduate credit.

E Sci 490. Independent Study. Cr. 2 to 5. *Prereq:* Permission of department chair. Investigation of an approved problem commensurate with the training, interest, and ability of the student. Nonmajor graduate credit.

H. Honors

E Sci 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of department chair; senior classification. Required of all cooperative students. Students must register for this course prior to commencing each work period.

Thomas L. Kent, Chair of Department

Distinguished Professors: Bowers

Professors: Bataille, Blyler, Carlson, Chapelle, Daly, Dearin, Douglas, Freed, Geha, Graham, Kent, McCarthy, Nakadate, Owen, Poague, Potter, Silet, Swander, Vann, Zimmerman

Distinguished Professors (Emeritus): Feinberg

Professors (Emeritus): Abraham, Anderson-Hsieh, Bruner, Davies, Drexler, Haggard, Herrnstadt, Nostwich, Underhill, Zbaracki

Associate Professors: Allen, Burnett, Catron, Consigny, David, Ewald, Gwiasda, Haas, J. Hagge, Hickok, Kienzler, Kostelnick, Kupfer, Mendelson, Miller, Payne, Pett, Post, Roberts, Russell, Schwarte, Thralls, Tremmel, Wallace, Whitaker, Winsor, Yager

Associate Professors (Emeritus): Galyon, Matthes, Ross, Speer

Assistant Professors: Amaya, Beatty, Conrad, Davis, D. Dunlop, M. Dunlop, Fresonke, Hegelheimer, Honeycutt, Kaufmann, Marquart, Niday, Slagell, St. Germain

Assistant Professors (Adjunct): Berry, Gilchrist, Huff, Li, Silver, Vallier

Assistant Professors (Emeritus): McCully

Instructors (Adjunct): Anderson, Barratt, Bertelsen, Bjurstrom, Douglas, Duffelmeyer, Graves, L. Hagge, Langenberg, Mahoney, Morgan, Myers, Noland, Schmidt

Undergraduate Study

The department offers a wide variety of courses for students seeking a degree in English, as well as for students wishing to broaden their general education. Offerings include classes in introductory college writing, literature, film, creative writing, rhetoric and professional communication, English education, linguistics, and teaching English as a second language.

The discipline of English helps to develop students' understanding of how language functions in literature, mass media, and both personal and professional writing. Students not pursuing an English major may select English courses to fill electives, to pursue a minor, or to complement their training in other majors.

Graduates will possess a broad-based knowledge and understanding of the discipline. They will also understand their particular disciplinary specialization, whether it be literary studies, rhetoric and professional communication, teacher education, creative writing, or teaching English as a second language/applied linguistics. Graduates will be able to write well-organized, well-reasoned essays that demonstrate their ability to read and think critically.

Introductory writing courses in the department are designed to improve the skills in communication and reading comprehension necessary for successful university work. The English Department maintains a Writing Center to assist students registered for writing courses. (See *Colleges and Curricula, Bachelor's Degree Requirements, and English Proficiency*

Policy for information about communication proficiency requirements for each Iowa State major. Note that the major requirements in many departments call for coursework beyond first-year composition.)

Through the Intensive English and Orientation Program, the department offers special courses in English for both undergraduate and graduate students who are native speakers of other languages. (See bulletin entries under *English Courses for Native Speakers of Other Languages* and *English Requirement for International Students*.)

Careers for English Majors

Students graduating with a major in English find that their career opportunities are improved in fields that require special communication skills, such as publishing, public service, research, business and technical writing, personnel management, international relations, advertising and marketing, finance, and public relations. An undergraduate major in English is an excellent basis for the professional study of law, medicine, theology, or business management. Students in English Education can qualify to teach English in middle or high school. (See *Index, Teacher Licensure*.) English majors may also pursue graduate studies in a number of communication-related fields.

English Major Requirements

The English major will choose from among three programs of study: Literature, Rhetoric and Professional Communication, and English Education. Students wishing to focus on creative writing should choose Literature as a program of study. English majors are required to have, in addition to first-year composition, at least 42 credits in English; those in English Education must have 48 credits in English in addition to required teaching-related courses taken in other departments. English majors transferring from other institutions must take at least 18 of their credits in English while in residence at Iowa State.

To graduate in English, a student must earn at least a C (not a C-) in English 104 and 105 as well as in each of the courses taken to fulfill the program of study. Earning at least a C in first-year composition and in one advanced writing class also meets the departmental English proficiency requirement.

Finally, all English majors must take some classes in early literature. Literature majors must take at least two pre-1800 literature classes. Rhetoric and Professional Communication majors and English Education majors must take at least one pre-1800 literature class and one pre-1900 literature class.

Distributed Requirements

All English majors, no matter what their program of study, must take nine courses for a total of 24 credits from a list of distributed requirements:

Engl 199	Introduction to the Study of English	R
Engl 219	Introduction to Linguistics	3
Engl 260	Introduction to Literary Study	3
Engl 310	Rhetorical Analysis	3
Engl 302-316	Advanced Writing	3
Engl 340-349	Women's or Minority Literature	3
Engl 360-364	American Literature	3
Engl 373-378	British Literature	3

Engl 300+	English Elective	3
		24

These distributed requirements may not overlap with any other English requirements.

Advanced Study Requirements

Each program of study has its own requirements for advanced work:

Literature

Engl 339	Literary Theory	3
Engl 360-364	American Literature	3
Engl 370-378	British Literature	3
Engl 400+	English Electives	6
Engl 440-463	Literature Seminar	3

Rhetoric and Professional Communication

Engl 350	Rhetoric and the History of Ideas	3
Engl 300+	Rhetoric and Professional Communication	6
Engl 400+	Rhetoric and Professional Communication	9

English Education

Engl 220	Descriptive Grammar	3
Engl 339	Literary Theory	3
Engl 360-364	American Literature	3
Engl 370-378	British Literature	3
Engl 392	Practice & Theory of Teaching Writing	3
Engl 394	Young Adult Literature	3
Engl 420	History of the English Language	3
Engl 494	Prac & Theory of Teaching Literature	3

There are a number of other course requirements outside of English for English Education majors. These requirements may overlap with General Education requirements for the college:

C I 201	Instructional Media	3
C I 204	Social Foundations of American Education	3
C I 280A	Pre-Student-Teaching Experience	2
C I 406	Multicultural Awareness and Nonsexism	2
C I 426	Principles of Secondary Education	3
LAS 417E	Student Teaching	12
LAS 480E	Field Experience for Secondary Teaching	2
CI St 353	World Literature	3
Psych 230	Human Growth and Development	3
Psych 333	Educational Psychology	3
Hist or Pol S	American History or Government	3
ComSt 102, Sp Cm 212, Sp Cm 313, or Thre 358	Health, Dance, Safety or Physical Education	3
		1

Minors and Second Majors

English majors are encouraged to seek a minor or a second major to complement their English studies. To find out the requirements for particular majors or minors, consult the section in this bulletin relating to the department offering the major or minor. Students in English Education are particularly encouraged to acquire secondary certification in another teaching area. Ask in the English Undergraduate Advising Office (Ross Hall 306) for a list of Iowa Secondary Certification requirements in various subject areas, or consult ISU's certification officer in the College of Education.

Degree Choices

English majors may earn a bachelor of arts or a bachelor of science degree. The B.S. degree requires an extra 12 credits beyond the general education requirements; these credits must be taken in linguistics, natural science, mathematics, social science, or selected courses in physical education.

English Minor Requirements

The department offers a minor in English, which students may earn by completing at least 18 credits in English courses beyond the 100 level. A student earning an English minor must take 9 of the 18 credits at the 300-level or above and must earn a grade of C (not C-) or higher in each course taken in the minor. No specific courses need be taken; students may design their minor programs around their own interests.

Departmental Awards and Scholarships

Each spring the English department offers many scholarships and awards. Some awards are for returning English majors only; others are for returning students of any major demonstrating excellence in some aspect of English study. A list of current awards and application forms are available in the English Advising Office, 306 Ross Hall, during late February. Award winners are announced each year on May 1 or shortly after.

Other Programs Associated with English

The English Department participates in inter-departmental programs in African American Studies, American Indian Studies, Classical Studies, Latino/a Studies, Linguistics, Theatre and Women's Studies. (See the *Index for requirements for these interdepartmental programs.*)

Graduate Study

The master of arts degree program in English offers varied possibilities for the advanced study of writing, language, and literature. Students are admitted to one of four areas of specialization: creative writing, teaching English as a second language/applied linguistics; literature; and rhetoric, composition, and professional communication. These areas of specialization are designed to prepare students for teaching at the secondary, two-year college, or beginning college and university levels; for further graduate study in language and literature; for teaching English as a second language; for creative writing; or for technical writing and business communication, editing, and associated professional writing.

The master's degree requires 30 semester credits, including a thesis or project (3 credits), and satisfaction of a language requirement that may be met through a number of options, including previous foreign language study, graduate linguistics courses, satisfactory performance on a test-out exam, and knowledge of statistical and/or data processing methods. A student whose native language is other than English is considered to have met the departmental language requirement after satisfying the Graduate College English requirement.

Graduate literature courses fall into three basic categories: methods courses, involving theories and methods and their applications in the teaching, reading, and scholarly study of literature; readings courses, covering a diverse selection of writers and primary and secondary texts across a broad period of time; and studies courses, involving intensive study of genre, gender, individual or clustered authors, and specific cultural, critical, or theoretical issues.

The Ph.D. in rhetoric and professional communication (RPC) focuses on the theory of rhetoric and the practice of written communication in professional communities such as business, industry, and government. The degree qualifies graduates for academic positions in rhetoric and in business and technical communication, as well as for work in the private sector as professional writing specialists, editors, and communications production managers. Prospective students must first secure admission to the graduate studies program through the Department of English. Candidacy for the RPC program is based on a qualifying exam. Candidates are required to complete 72 hours of graduate credit and a dissertation, and to pass a qualifying exam, a preliminary exam, and an oral defense of the dissertation.

The department offers graduate students an opportunity to gain professional experience through professional writing internships, selected departmental research activities, the Intensive English and Orientation Program, the First-Year Composition Program, the Interpersonal and Rhetorical Communication Program, and the Writing Center. Teaching and research assistantships are available for qualified students. Teaching assistants are responsible for teaching, with faculty supervision, classes in first-year composition, in public speaking, in English as a second language, and in business and technical communication. Research assistants are assigned to individual faculty members engaged in projects in writing, language, or literature. One or more Pearl Hogrefe Fellowships covering stipend and tuition are awarded each year to outstanding graduate students. Several Freda Huncke Graduate Teaching Fellowships are available to first-year Ph.D. students.

With prior written approval from the College of Education, students may take English courses to meet part of the requirements for certification to teach English in two-year and community colleges. Selected courses may also be used to meet requirements for ESL endorsement (K-12) for teachers.

A graduate minor in English at the M.A. level requires 9 credits of English, 6 of which must be in 500 or 600 level courses. A graduate minor in English at the Ph.D. level requires 12 credits of English, 9 of which must be in 500 or 600 level courses.

Courses open for nonmajor graduate credit: 302, 309, 313, 314, 315, 335, 340, 345, 346, 347, 348, 349, 357, 358, 394, 415, 416, 418, 420, 422, 425, 440, 441, 450, 451, 452, 453, 460, 461, 463, 487.

Courses Primarily for Undergraduate Students

Engl 10. Intensive English and Orientation Program. (20-5) Cr. 0. F.S.S.S. *Prereq:* *Recommendation of the English Department.* Full-time study of English for speakers of other languages. Brochure available from the IEOP Office, 337 Ross Hall. Offered on a satisfactory-fail grading basis only.

Engl 101. English for Native Speakers of Other Languages. F.S. *Prereq:* *Recommendation of English Department; placement in various sections is determined by examination. (See English Requirement for International Students in Index.)* For undergraduates: Completion of English 101 requirement prepares students for English 104. For gradu-

ates: Completion of English 101 satisfies the English requirement of the Graduate College. Engl 101 course are limited to students who are nonnative speakers of English. Credit from 101 does not count toward graduation.

B. Academic English I—Cr. 3. Available P/NP to graduate students at their department's option.

C. Academic English II—Undergraduates. Cr. 3.

D. Academic English II—Graduates. Cr. 3. Available P/NP to graduate students at their department's option.

L. Strategies for Listening. Cr. 2. Available P/NP to graduate students at their department's option.

R. Strategies for Reading. Cr. Var. 1-2. Available P/NP to graduate students at their department's option.

Engl 104. First-Year Composition I. (3-0) Cr. 3.

F.S.SS. Introduction to college-level writing strategies with emphasis on critical reading and thinking skills. Six to eight major writing assignments with readings from a variety of sources.

Engl 105. First-Year Composition II. (3-0) Cr. 3. F.S.SS. *Prereq: 104 or exemption from 104; credit for or concurrent enrollment in Lib 160.* Development of college-level writing strategies with emphasis on arguing a position, analyzing texts, and using primary and secondary sources. Five to seven major writing assignments.

Engl 105H. First-Year Composition, Honors. (3-0) Cr. 3. F. *Prereq: Exemption from 104 and admission to Freshman Honors Program; credit for or concurrent enrollment in Lib 160.* A rhetorical approach to topics in language, literature, and culture. Reading and writing assignments may be organized around a course theme or focus. Writing intensive.

Engl 180. Communication Skills for International Teaching Assistants. (Same as U St 180.) Cr. 1 to 3. F.S. Placement based upon SPEAK/TEACH test results. Persons whose native language is English cannot take 180 for credit. No more than one section of 180 may be taken per semester: up to two sections total. Credit does not apply toward graduation. Offered on a satisfactory-fail grading basis only.

A. Speaking Skills. Cr. 3. Emphasis on pronunciation improvement and greater fluency in spoken English for teaching purposes.

B. Intermediate Spoken English. Cr. 3. Interactive speaking and response to questions are emphasized.

C. Advanced Spoken English. Cr. 3. For students who have completed 180A or 180B but have not reached the passing level on the SPEAK/TEACH test.

D. Presentation Skills. Cr. 3. Developing explanations, leading discussions and handling questions in a teaching environment.

E. Supervised Independent Study. Cr. 1. Seminar with individual observation and consultation.

Engl 199. Introduction to the Study of English.

(2-0) Cr. R. F.S. 8 weeks. *Prereq: 105.* General introduction to the discipline; discussion of the various fields in English; consideration of career opportunities. Offered on a satisfactory-fail grading basis only.

Engl 201. Introduction to Literature. (3-0) Cr. 3.

F.S.SS. *Prereq: Credit in or exemption from 104.* Study of selected examples of drama, poetry, short fiction, and the novel drawn from both British and American literature. Emphasis on becoming an active reader. Recommended for non-majors.

Engl 205. Popular Culture Analysis. (3-0) Cr. 3. F.S.

Prereq: 105. Analysis of how popular information and entertainment forms persuade and manipulate audiences. Study of several forms that may include newspapers, television, film, advertising, fiction, and magazines. Special attention to verbal and visual devices. Materials fee.

Engl 219. Introduction to Linguistics. (Same as

Ling 219.) (3-0) Cr. 3. F.S. *Prereq: Sophomore classification.* Introduction to linguistic concepts and principles of linguistic analysis with English as the primary source of data. Sound and writing systems, sentence structure, vocabulary, and meaning. Issues in the study of usage, regional and social dialects, language acquisition, and language change.

Engl 220. Descriptive English Grammar. (Same as Ling 220.) (3-0) Cr. 3. F.S. *Prereq: 105.* Overview of English structural grammar, focusing on the tradition-

al parts of speech; phrase, clause, and sentence structure; sentence types and sentence diagramming; and basic terminology. Intended primarily for prospective teachers and focused on formal written English. May cover these additional areas: analysis of common errors, standard usage, rhetorical grammar. Not a remedial course or an English composition course.

Engl 230. Literature in British Culture. (3-0) Cr. 3.

F.S. *Prereq: Credit in or exemption from 104.* Selected literary texts chosen for their attention to important trends, values, attitudes, ideals, and beliefs of our own and past times.

Engl 231. Literature in American Culture. (3-0) Cr.

3. F.S. *Prereq: Credit in or exemption from 104.* Selected literary, critical, and visual texts chosen for their attention to important trends, attitudes, ideals, and beliefs of contemporary and past times.

Engl 237. Survey of Film History. (3-0) Cr. 3. F.

Prereq: 105. A survey of the history of film, both U.S. and international, from the beginnings in the late nineteenth century to the present. Materials fee.

Engl 260. Introduction to Literary Study. (3-0)

Cr. 3. F.S. *Prereq: Credit in or exemption from 104.* Basic principles of literary study. Emphasis on writing of interpretive and critical essays. Particular attention to poetry. Designed for English majors.

Engl 301. Cultural Studies. (3-0) Cr. 3 each time

taken, maximum of 6. F.S. *Prereq: 105.* Literature and related arts and cultural phenomena, with focus on a specific group, subgroup, identity cluster, or phenomenon. Selected texts, artifacts, and cultural experiences.

Engl 302. Business Communication. (3-0) Cr. 3.

F.S.SS. *Prereq: 105, junior classification.* Theory, principles and processes of effective written communication typically encountered in business and the professions. Extensive writing practice in standard letter and memo forms, short proposals, policy and procedure descriptions, job descriptions, application letters, résumés, autobiographical précis, performance reviews and evaluations, and letters of recommendation. H. Honors. Nonmajor graduate credit.

Engl 303. Free Lance Writing for Popular

Magazines. (3-0) Cr. 3. S. *Prereq: 105.* Practical workshop in writing nonfiction articles for popular magazines. Emphasis on writing, market research, preparation of manuscripts, methods of submission. Major goal of the course is production of marketable material.

Engl 304. Creative Writing—Fiction. (3-0) Cr. 3. F.S.

Prereq: 105, not open to freshmen. Progresses from practice in basic techniques of fiction writing to fully developed short stories. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

Engl 305. Creative Writing—Nonfiction. (3-0) Cr. 3.

F.S. *Prereq: 105, not open to freshmen.* Workshop in writing imaginative essays, both critical and personal. Analytical reading, development of literary techniques. Individual and small group conferences.

Engl 306. Creative Writing—Poetry. (3-0) Cr. 3. F.S.

Prereq: 105, not open to freshmen. Progresses from traditional to contemporary forms. Emphasis on writing, analytical reading, workshop criticism, and individual conferences.

Engl 307. Writing and Publishing Young Adult

Fiction. (3-0) Cr. 3. S. *Prereq: 105, not open to freshmen.* Workshop in writing short stories and novels for young adults. Emphasis on audience, technique, and current publication possibilities. Individual and small group conferences.

Engl 309. Report and Proposal Writing. (3-0) Cr. 3.

F.S. *Prereq: 105, junior classification.* Nature, function, and types of reports and proposals. Analysis of readers, methods of research, procedures for drafting and revision, design of layouts. Extensive writing practice with reports and proposals. Nonmajor graduate credit.

Engl 310. Rhetorical Analysis. (3-0) Cr. 3. F.S.

Prereq: Credit in or exemption from 105. Fundamental principles of rhetorical study. Emphasis

on basic rhetorical theory. Particular attention to analysis of non-literary texts.

Engl 313. Writing for the World Wide Web. (3-0)

Cr. 3. F.S. *Prereq: 105, junior classification.* Rhetorical principles of hypertextual writing and publishing. Group and individual projects using HyperText Markup Language to construct interactive sites for the World Wide Web. Special emphasis on business and technical applications. Nonmajor graduate credit.

Engl 314. Technical Communication. (3-0) Cr. 3.

F.S.SS. *Prereq: 105, junior classification.* Theories, principles, and processes of effective written communication in the technical disciplines. Attention to the major strategies for composing technical discourse; techniques of analyzing audiences and writing situations, and for organizing data and information. H. Honors. Nonmajor graduate credit.

Engl 315. Creative Writing—Screenplays. (3-0)

Cr. 3. F. *Prereq: 105, not open to freshmen.* Stresses master scene technique of writing fully developed screenplays. Emphasis on TV and movie techniques, writing, workshop criticism, analytical reading and viewing, and individual conferences. Nonmajor graduate credit.

Engl 316. Creative Writing—Playwriting. (Same as

Thre 316.) (3-0) Cr. 3. S. *Prereq: 105, not open to freshmen.* Progresses from production of scenes to fully developed one-act plays. Emphasis on action, staging, writing, analytical reading, workshop criticism, and individual conferences.

Engl 330. Science Fiction. (3-0) Cr. 3. F.S. *Prereq:*

105. Development of science fiction from its origins in nineteenth-century fiction to the present. Emphasis on reading protocols developed through Golden Age, New Wave, and post-1970s fiction.

Engl 335. Film. (3-0) Cr. 3 each time taken, maximum of 6.

F.S. *Prereq: 105.* Principles of film art and the traditional vocabulary of literature as applied to film. Influence of film on modes of thought and behavior. Materials fee. Nonmajor graduate credit.

Engl 339. Literary Theory and Criticism. (3-0) Cr. 3.

F.S. *Prereq: 260 and 3 additional credits in literature.* Study of selected texts of literary criticism, with attention to the purposes and practices of criticism.

Engl 340. Survey of Women's Literature. (Same as

W S 340.) (3-0) Cr. 3. F.S. *Prereq: 105.* Historical and thematic survey of literature by and about women. May include autobiographies, journals, letters, poetry, fiction, and drama. Nonmajor graduate credit.

Engl 344. Latino/a Literature. (3-0) Cr. 3. S. An introduction

to the literature of Mexican American, Puerto Ricans, Cuban Americans and other Latina/s subgroups. Special emphasis on themes such as ethnic relations and comparisons with Euroamerican literary traditions.

Engl 345. Women and Literature: Selected Topics.

(Same as W S 345.) (3-0) Cr. 3 each time taken, maximum of 6. S. *Prereq: 105.* Literature by women and/or dealing with the images of women, e.g., study of individual authors or related schools of authors; exploration of specific themes or genres in women's literature; analysis of recurrent images of women in literature. Nonmajor graduate credit.

Engl 346. American Indian Literature. (Same as

Am In 346.) (3-0) Cr. 3. S. *Prereq: 105.* Survey of literature by Native Americans from pre-Columbian tales and songs to contemporary novels and poetry. Nonmajor graduate credit.

Engl 347. Survey of African American Literature.

(Same as Af Am 347.) (3-0) Cr. 3. F. *Prereq: 105.* Literature by African Americans from the beginnings to the 1960s. Nonmajor graduate credit.

Engl 348. Contemporary African American

Literature. (Same as Af Am 348.) (3-0) Cr. 3. S. *Prereq: 105.* Intensive reading in literature by African Americans from 1960 to the present. Nonmajor graduate credit.

Engl 349. Selected Topics in Minority Literatures

of the United States. (Same as Af Am 349.) (3-0) Cr. 3 each time taken, maximum of 6. S. *Prereq: 105.* Literature of American ethnic and minority groups.

May include literature of several groups or focus upon one of the following: Asian Americans, African Americans, Hispanic Americans, American Indians. Nonmajor graduate credit.

Engl 350. Rhetoric in Social and Historical Contexts. (3-0) Cr. 3. S. *Prereq:* 105 and *junior classification*. An exploration of the relationship between rhetoric and society in contemporary and historical contexts. Sample topics: rhetorical theory in relation to politics, gender, race, ethics, education, science.

Engl 353. World Literature: Western Foundations through Renaissance. (Same as Cl St 353.) (3-0) Cr. 3. F. *Prereq:* 105. Representative works from the drama, epics, poetry, and prose of the Ancient World through the late sixteenth century. May include Homer, Aeschylus, Sappho, Catullus, Dante, Marie de France, Boccaccio, Christine de Pizan, Cervantes, and others.

Engl 354. World Literature: Seventeenth through Twentieth-Century. (3-0) Cr. 3. S. *Prereq:* 105. Representative works primarily from European traditions of drama, fiction, poetry, and nonfiction.

Engl 356. Literary Study of the Bible. (3-0) Cr. 3. S. *Prereq:* 105. Selected readings from Judaic and Christian sacred literature, including narrative, poetry, wisdom literature, and apocalyptic literature.

Engl 357. Folklore. (3-0) Cr. 3. F. *Prereq:* 105. Types, functions, contexts, and purposes of folklore. Emphasis on traditional narratives and verbal folklore. Nonmajor graduate credit.

Engl 358. Myth, Fairytale and Legend. (3-0) Cr. 3. S. *Prereq:* 105. Study of traditional fairytales, myths, and legends from diverse cultures. Nonmajor graduate credit.

Engl 360. American Literature: Beginnings to 1830. (3-0) Cr. 3. F.S. *Prereq:* 105; *sophomore classification*. American literature from its beginnings through the colonial period to early romanticism; literary works in their social and cultural contexts.

Engl 362. American Literature: 1830 to 1914. (3-0) Cr. 3. F.S. *Prereq:* 105; *sophomore classification*. Romanticism, realism, and naturalism in American literature; literary works in their social and cultural contexts.

Engl 364. American Literature: 1914- present. (3-0) Cr. 3. F.S. *Prereq:* 105; *sophomore classification*. American literature since World War I; literary works in their social and cultural contexts.

Engl 366. Studies in Drama. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 105. Dramatic literature in its historical and cultural contexts. Particular plays and national dramas studied will vary.

Engl 370. Shakespeare. (3-0) Cr. 3. F.S.S.S. *Prereq:* 105. Reading and analysis of selected plays. Development of Shakespeare's dramatic art in its social and intellectual context.

Engl 373. British Literature: The Middle Ages. (3-0) Cr. 3. F.S. *Prereq:* 105; *sophomore classification*. Medieval literature (*Beowulf* through the fifteenth century), considered in social and intellectual contexts.

Engl 374. British Literature: The Renaissance. (3-0) Cr. 3. F.S. *Prereq:* 105; *sophomore classification*. Literature from 1500 to 1660 considered in social and intellectual contexts.

Engl 375. British Literature: The Restoration and 18th Century. (3-0) Cr. 3. F.S. *Prereq:* 105; *sophomore classification*. Literature from 1660 to 1800 considered in social and intellectual contexts.

Engl 376. British Literature: Romantic and Victorian. (3-0) Cr. 3. F.S. *Prereq:* 105; *sophomore classification*. Literature from the late eighteenth century to about 1900, considered in social and intellectual contexts.

Engl 378. British Literature: Modern and Contemporary. (3-0) Cr. 3. S. *Prereq:* 105; *sophomore classification*. British literature since about 1900 considered in social and intellectual contexts.

Engl 384. Twentieth-Century Fiction. (3-0) Cr. 3. F.S. *Prereq:* 105. Works by writers from various

countries, including the United States or Great Britain.

Engl 389. Postcolonial Literatures. (3-0) Cr. 3. S. *Prereq:* 105. History, theory, and practice of postcolonial literature written in English. Selected reading from one or more postcolonial literatures.

Engl 392. Practice and Theory of Teaching Writing in the Secondary Schools. (3-0) Cr. 3. F.S. *Prereq:* 219 or 220. Introduction to teaching secondary language arts. Current theories and practices in the teaching of writing to secondary school students. Theories of rhetoric, approaches to teaching, lesson design and planning. Evaluating writing. Professional portfolio preparation. (Taken concurrently with C I 280. Cr. 2.)

Engl 393. The History of Children's Literature. (3-0) Cr. 3. F. *Prereq:* 105. Origin and development of English and American children's literature through the nineteenth century. Special emphasis on nature, structure, and enduring themes of fantasy literature.

Engl 394. Young Adult Literature. (3-0) Cr. 3. F. *Prereq:* 105. Critical study and evaluation of the genre: examination of modes and themes found in the literature; study of the relationship of the genre to children's literature and adult literature. Evaluation of literature for use in school programs. Restricted to students seeking teachers certification. Nonmajor graduate credit.

Engl 395. Study Abroad. Cr. var. SS. *Prereq:* *Permission of instructor*. Supervised study of an appropriate area of the discipline in a foreign country. Special fees apply.
A. Literature.
B. Creative Writing.
C. Linguistics.
D. Rhetoric and Professional Communication.
E. Teacher Education.

Engl 398. Cooperative Education. Cr. R. F.S.S.S. *Prereq:* *Permission of the department cooperative education coordinator; junior or senior classification*. Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

Engl 404. Creative Writing Workshop—Fiction. (3-0) Cr. 3 each time taken, maximum of 6. F.S. *Prereq:* 304. Individual projects in creative writing. Emphasis on advanced writing techniques, workshop criticism, and individual conferences.

Engl 405. Creative Writing Workshop—Nonfiction. (3-0) Cr. 3 each time taken, maximum of 6. F.S. *Prereq:* 305. Individual projects in creative writing. Emphasis on advanced writing techniques, workshop criticism, and individual conferences.

Engl 406. Creative Writing Workshop—Poetry. (3-0) Cr. 3 each time taken, maximum of 6. F.S. *Prereq:* 306. Individual projects in creative writing. Emphasis on advanced writing techniques, workshop criticism, and individual conferences.

Engl 415. Business and Technical Editing. (3-0) Cr. 3. F.S. *Prereq:* 302, or 309, or 314; *junior classification*. Editing journal articles, research reports, technical manuals, newsletters, and proposals. Attention to editorial levels and styles, project management, editor-author relationships, and electronic editing. Nonmajor graduate credit.

Engl 416. Graphic Communication in Business and Technical Writing. (3-0) Cr. 3. F.S. *Prereq:* 302, or 309, or 314; *junior classification*. Rhetorical aspects of visual communication in business and technical writing. Issues in the design of text, charts, graphs, diagrams, schematics, illustrations, and other visual displays. Projects drawn from student's discipline. Nonmajor graduate credit.

Engl 418. Argumentative Writing. (3-0) Cr. 3. S. *Prereq:* 310, 350; *junior classification*. Advanced seminar in principles, theory, and analysis of argumentation. Extensive practice in argumentative writing. Nonmajor graduate credit.

Engl 419. Grammatical Analysis. (Dual-listed with 516. Same as Ling 419.) (3-0) Cr. 3. F. *Prereq:* 219 or an *introductory course in linguistics, junior classification*. Theories and methods for analysis of English syntax with emphasis on recent syntactic theory.

Engl 420. History of the English Language. (Same as Ling 420.) (3-0) Cr. 3. F.S. *Prereq:* 219 or *equivalent introduction to linguistics; 220 or equivalent course in descriptive English grammar; 3 credits in British literature before 1700 recommended*. Historical study of the English language. Comparison of English to other languages by family background and by type. Analysis of representative Old, Middle, Early Modern and present-day English texts, including both literary works and non-literary documents. Some attention paid to the uses of historical linguistics in the teaching of English. Nonmajor graduate credit.

Engl 422. Women, Men, and the English Language. (Same as Ling 422 and W S 422.) (3-0) Cr. 3. S. *Prereq:* 219 or an *introductory course in linguistics*. The ways men and women differ in using language in varied settings and the ways in which language both creates and reflects gender divisions. Nonmajor graduate credit.

Engl 423. Introduction to Old English Language and Literature. (Dual-listed with 523.) (3-0) Cr. 3. F. *Prereq:* *Junior classification, 373 or 420 recommended*. Introductory study of Old English language and literature in prose and poetry, including extracts from *Beowulf*. Some attention to Anglo-Saxon culture.

Engl 425. Second Language Learning and Teaching. (Same as Ling 425.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 219 or an *introductory course in linguistics; junior classification*. The process of second language learning and principles and techniques of teaching second languages. Learning and teaching in specific situations and for particular purposes. Current applications of technology in teaching and assessment. Nonmajor graduate credit.

Engl 440. Seminar in British Literature. (3-0) Cr. 3 each time taken. F. *Prereq:* *Completion of or concurrent enrollment in 339*. Selected authors, movements, eras, or genres in British literature. Readings in criticism. Nonmajor graduate credit.

Engl 441. Seminar in American Literature. (3-0) Cr. 3 each time taken. S. *Prereq:* *Completion of or concurrent enrollment in 339*. Selected authors, movements, eras, or genres in American literature. Readings in criticism. Nonmajor graduate credit.

Engl 450. Seminar in Drama. (3-0) Cr. 3 each time taken. F. *Prereq:* *Completion of or concurrent enrollment in 339*. Selected authors, movements, eras, or national literatures. Readings in criticism. Nonmajor graduate credit.

Engl 451. Seminar in Poetry. (3-0) Cr. 3 each time taken. S. *Prereq:* *Completion of or concurrent enrollment in 339*. Selected authors, movements, eras, or national literatures. Readings in criticism. Nonmajor graduate credit.

Engl 452. Seminar in Prose. (3-0) Cr. 3 each time taken. S. *Prereq:* *Completion of or concurrent enrollment in 339*. Selected authors, movements, eras, or national literatures. May include the novel, the short story, the essay, or autobiography. Readings in criticism. Nonmajor graduate credit.

Engl 453. Seminar in Film. (3-0) Cr. 3 each time taken. Alt. S., offered 2000. *Prereq:* *Completion of or concurrent enrollment in 339*. Film history, theory, genre, or authorship. Readings in criticism. Materials fee. Nonmajor graduate credit.

Engl 460. Seminar in Women's and/or Minority Literature. (3-0) Cr. 3 each time taken. F. *Prereq:* *Completion of or concurrent enrollment in 339*. Selected readings of various authors, movements, eras, or genres. Readings in criticism. Nonmajor graduate credit.

Engl 461. Seminar in Single Figure Study: Canon and Context. (3-0) Cr. 3 each time taken. Alt. F., offered 2000. *Prereq:* *Completion of or concurrent enrollment in 339*. Single figure (e.g. Austen, Chaucer, Milton, Morrison, Twain, or Woolf) studied through literary, social, critical, and historical contexts. Nonmajor graduate credit.

Engl 463. Seminar in Literature and Culture. (3-0) Cr. 3 each time taken. F. *Prereq:* *Completion of or concurrent enrollment in 339*. Interrelationships among literary works, social and historical contexts,

and reception. Texts by several authors. Readings in criticism. Nonmajor graduate credit.

Engl 487. Internship in Business, Technical, and Professional Writing. Cr. 1 to 3. S. *Prereq: 6 credits in 302, 309, 314, 415 (preferred), or 416, and permission of coordinator.* An opportunity to write, edit, and design business and technical documents in a professional setting. Projects include reports, proposals, manuals, brochures, newsletters. Nonmajor graduate credit.

Engl 489. Undergraduate Seminar. (Same as Ling 489.) (3-0) Cr. 3 each time taken. S. *Prereq: 9 credits in English beyond 105.* Intensive study of a selected topic in literature, criticism, rhetoric, writing, or language. Cross-listing with linguistics acceptable only when offered as a course in linguistics.

Engl 490. Independent Study. Cr. var. F.S. *Prereq: 9 credits in English beyond 105 appropriate to the section taken, junior classification, permission of Undergraduate Studies Committee.* No more than 9 credits of Engl 490 may be used toward graduation. Designed to meet the needs of students who wish study in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields.

- A. Literature
- B. Linguistics, Semantics (Ling 490B)
- C. Rhetoric, Teaching of Composition
- D. Criticism and Theory of Literature
- E. Reading: Instructional Methods and Research
- F. Creative Writing
- G. Business/Technical Communication
- H. Honors

Engl 494. Practice and Theory of Teaching Literature in the Secondary Schools. (Same as C 1494.) (3-0) Cr. 3. F.S. *Prereq: 310, 392, 18 credits in English beyond 105, Psych 333, admission to teacher education program.* Portfolio review. Current theories and practices in the teaching of literature to secondary school students. Integrating literary study and writing. Preparation and selection of materials. Classroom presentation. Unit planning.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

(Open on a priority basis to graduate students admitted to one of the degree programs in English; open by permission of instructor to other qualified graduate students and to qualified undergraduates.)

Engl 500. Proseminar: Teaching English Composition. (3-0) Cr. 3. F.S. *Required of all new English teaching assistants.* Introduction to the teaching of English 101 and 104/105. Current theories and practices related to 101 and 104/105 objectives, lesson planning and teaching methods, development of writing assignments, evaluation of student writing.

Engl 503. Teaching Composition: Theory and Research. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: 6 credits in English.* Consideration of current pedagogic theories and research in composition/rhetoric.

Engl 504. Teaching Business and Technical Writing. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 302, 309, 314, or 392.* Theory and practice of teaching college courses in business and technical writing. Some consideration of in-service writing courses for business and government. Emphasis on applicable communication and composition theory, curriculum planning, assignment design, materials development.

Engl 505. Technology in Business, Technical, and Professional Communication. (3-0) Cr. 3. Alt. S., offered 2001. Examination of the role of technology, especially computer technology, in communication practices within academic and workplace settings.

Engl 506. Theory and Research in Professional Communication. (3-0) Cr. 3. S. *Prereq: 6 credits in English, permission of instructor.* Introduction to contemporary theories of written discourse; emphasis on the implications of these theories for research in professional communication.

Engl 507. Writing and Analyzing Professional Documents. (3-0) Cr. 3. F. *Prereq: 6 credits in*

English, permission of instructor. Introduction to the theory and practice of writing and analyzing documents prepared in business, science, industry, and government. Guided readings; individual projects.

Engl 508. Advanced Workshop in Academic Writing. (3-0) Cr. 3. Alt. SS., offered 2001. *Prereq: 6 graduate credits.* Hands-on practice in writing academic discourse for publication; rhetorical analyses of student-selected academic journals; discussion of current trends in academic writing; professional perspectives on the referee process and on journal editorial decision making. Focus on the writing of selected short pieces (opinion essays, standard reviews, conference-length papers) and of article-length manuscripts.

Engl 509. Writing Proposals and Grant Applications. (3-0) Cr. 3. F. *Prereq: 6 credits in English composition.* Theories of written communication as applied to persuasive discourse. Writing and analysis of proposals or grant applications to businesses, governmental agencies, and private and corporate foundations.

Engl 510. Computer Methods for Language Study. (3-0) Cr. 3. F. *Prereq: Graduate classification.* Use of applications software for language teaching, linguistic analysis, and statistical analysis. Issues and problems in applied linguistics related to computer methods.

Engl 511. Introduction to Linguistic Analysis. (Same as Ling 511.) (3-0) Cr. 3. F. *Prereq: Graduate classification.* Principles and methods of linguistic analysis with emphasis on phonology, morphology, and syntax. Description of linguistic variation and current theoretical approaches to linguistics.

Engl 512. Linguistic Change in English: Historical Analysis of Literary and Non-Literary Texts. (Same as Ling 512.) (3-0) Cr. 3. S. *Prereq: Graduate classification.* Linguistic change in English, connections to literary and rhetorical history. Development of formal written English and its conventions. Historical survey of ideas about the English language.

Engl 514. Sociolinguistics. (Same as Ling 514.) (3-0) Cr. 3. S. *Prereq: 511 or an introductory course in linguistics.* Theories and methods of examining language in its social setting. Analysis of individual characteristics (e.g., age, gender, ethnicity, social class, region), interactional factors (e.g., situation, topic, purpose) and national policies affecting language use.

Engl 516. Grammatical Analysis. (Dual-listed with 419. Same as Ling 516.) (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Theories and methods for analysis of English syntax with emphasis on the functions of language.

Engl 517. Second Language Acquisition. (Same as Ling 517.) (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Theory, methods, and results of second language acquisition research with emphasis on approaches relevant to second language teaching.

Engl 518. Teaching English as a Second Language Methods and Materials. (Same as Ling 518.) (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Issues in methods, techniques, materials, curriculum design, and evaluation for all levels of ESL instruction. Practical application including group and individual projects.

Engl 519. Second Language Assessment. (3-0) Cr. 3. S. *Prereq: 517.* Principles of second language assessment including reliability, validity, authenticity and practicality. Constructing, scoring, interpreting, and evaluating second language tests for a variety of situations.

Engl 521. Teaching of Literature and the Literature Curriculum. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: 6 credits in literature.* Examination of the roles of the literary work, reader, and teacher in literary study. Responses to literature. Place of literature in language arts. Study and development of curriculum materials for varied levels of instruction.

Engl 522. Literary Theory and Criticism. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 6 credits in literature.*

Examination of the history, logic, and rhetoric of contemporary literary criticism and analysis.

Engl 523. Introduction to Old English Language and Literature. (Dual-listed with 423.) (3-0) Cr. 3. F. *Prereq: Graduate classification, course in medieval literature or history or history of the English language recommended.* Introductory study of Old English language and literature in prose and poetry, including extracts from Beowulf. Some attention to Anglo-Saxon culture.

Engl 524. Literacy: Issues and Methods for Nonnative Speakers of English. (Same as Ling 524.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 511 or an introductory course in linguistics.* Issues related to education in a variety of situations, including children and adults at basic skills levels as well as teens and adults in academic, professional, and vocational programs.

Engl 525. Methods in Teaching Listening and Speaking Skills to Nonnative Speakers of English. (Same as Ling 525.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: 511 or an introductory course in linguistics.* Theoretical and practical issues and techniques in the teaching of second language pronunciation, listening, and speaking skills to diverse student populations. Topics will be relevant to those intending to teach in various situations, including K-12 and adult learners in academic, professional, and vocational programs.

Engl 526. Computer-Assisted Language Learning. (Same as Ling 526.) (3-0) Cr. 3. S. *Prereq: 511 and 513 or equivalent.* Theory, research, and practice in computer use for teaching non-native speakers of English. Methods for planning and evaluating computer-based learning activities.

Engl 527. Discourse Analysis. (Same as Ling 527.) (3-0) Cr. 3. S. *Prereq: 511 or an introductory course in linguistics.* Methods and theoretical foundations for linguistic approaches to discourse analysis. Applications of discourse analysis to the study of texts in a variety of settings, including academic and research contexts.

Engl 528. English for Specific Purposes. (3-0) Cr. 3. F. *Prereq: 511 or an introductory course in linguistics.* Issues and techniques in analyzing, teaching, and assessing English for specific purposes. Topics include theories of specific purpose language use, analysis of learner needs in target language contexts, and syllabus and materials development for teaching and assessment.

Engl 530. Methods of Literary Scholarship. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: 6 credits in literature.* An introduction to kinds, purposes, and methods of research commonly pursued by literary scholars.

Engl 531. Readings in Literature. (3-0) Cr. 3 each time taken, maximum of 6. F. *Prereq: 6 credits in literature.* Numerous primary texts from a range of authors drawn from a broad period; secondary readings; e.g., Science and Literary Imagination; Colonial and Post-Colonial Novel; Science Fiction.

Engl 532. Readings in American Literature and Culture. (3-0) Cr. 3 each time taken, maximum of 6. F. *Prereq: 6 credits in literature.* Numerous primary texts by authors drawn from a broad period; secondary readings; e.g., Early American Literature; American Regionalisms; Nineteenth-Century American Fiction; Modernism and Postmodernism.

Engl 533. Readings in British Literature and Culture. (3-0) Cr. 3 each time taken, maximum of 6. S. *Prereq: 6 credits in literature.* Numerous primary texts by authors drawn from a broad period; secondary readings; e.g., Renaissance Literature; Restoration and Eighteenth Century; British Modernism.

Engl 545. Readings in Women's Literature. (Same as W S 545.) (3-0) Cr. 3 each time taken, maximum of 6. Alt. S., offered 2001. *Prereq: 6 credits in literature.* Numerous primary texts by women writers; historical, thematic, formal, or theoretical approaches; secondary readings; e.g., Nineteenth-Century British Women Writers; American Women's Personal Narratives; Reading Women into Modern Drama.

Engl 547. The History of Rhetorical Theory I: From Plato to Bacon. (3-0) Cr. 3. F. *Prereq: 6 credits in English, permission of instructor.* Principles of Classical, Medieval, and Renaissance rhetoric; emphasis on their relation to writing.

Engl 548. The History of Rhetorical Theory II: From Bacon to the Present. (3-0) Cr. 3. S. *Prereq: 6 credits in English, permission of instructor.* Principles of rhetoric from the early modern period (Bacon, Descartes, and Locke) to the present; emphasis on their relation to writing.

Engl 549. Readings in Minority Literatures. (3-0) Cr. 3 each time taken, maximum of 6. Alt. S., offered 2000. *Prereq: 6 credits in literature.* Numerous primary texts by ethnic/minority writers; secondary readings: e.g., Native American and Asian American Writing since 1950; African American Writing from the Civil War to the Cold War; The Harlem Renaissance.

Engl 554. Advanced Imaginative Writing: Fiction. (3-0) Cr. 3 each time taken, maximum of 12. F.S. *Prereq: For students not formally admitted to the creative-writing specialization, submission of acceptable portfolio and permission of instructor.* Individual projects in short fiction on a workshop and conference basis.

Engl 555. Advanced Imaginative Writing: Nonfiction. (3-0) Cr. 3 each time taken, maximum of 12. F. *Prereq: Graduate classification.* Individual projects in memoir, narrative, and personal essay on a workshop and conference basis.

Engl 556. Advanced Imaginative Writing: Poetry. (3-0) Cr. 3 each time taken, maximum of 12. F.S. *Prereq: For students not formally admitted to the creative-writing specialization, submission of acceptable portfolio and permission of instructor.* Individual projects in poetry on a workshop and conference basis.

Engl 557. Studies in Creative Writing. (3-0) Cr. 3 each time taken, maximum of 12. F. Alt. S., offered 2000. *Prereq: 3 credits in graduate creative writing.* Ideas, issues, and techniques in creative writing. Subject matter may include specific genres, aspects of the creative writing process, or themes of particular interest. Significant written work required; previous workshop experience helpful.

Engl 558. Teaching Creative Writing. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: 3 credits in creative writing.* Approaches effective for grade-school through adult-education classes. Writing exercises, workshops, text evaluation, and visits from creative writers.

Engl 559. Creative Writing Teaching Internship. Cr. 1 to 3. Alt. S., offered 2001. *Prereq: Concurrent enrollment in 558, permission of English graduate committee.* Students assist in an introductory creative writing class. Some supervised teaching but mainly evaluation of submissions and individual conferences. Requirements and grades determined by participating instructors.

Engl 561. Studies in Drama. (3-0) Cr. 3 each time taken, maximum of 6. Alt. S., offered 2001. *Prereq: 6 credits in literature.* Intensive study of drama: historical, thematic, formal, or theoretical approaches; e.g., Elizabethan and Jacobean Theater; Women Playwrights; Contemporary Drama.

Engl 563. Studies in American Prose. (3-0) Cr. 3 each time taken, maximum of 6. F. *Prereq: 6 credits in literature.* Intensive study of three or more writers of fiction, nonfiction, or a combination; e.g., American Autobiography; American Novel; Contemporary American Short Fiction.

Engl 566. Studies in American Poetry. (3-0) Cr. 3 each time taken, maximum of 6. Alt. S., offered 2001. *Prereq: 6 credits in literature.* Intensive study of poetic genres; major movements or periods; three or more poets; e.g., Modern American Long Poem; National Identity and Modern Poetry; Contemporary American Poetry.

Engl 567. Studies in British Poetry. (3-0) Cr. 3 each time taken, maximum of 6. Alt. F., offered 1999. *Prereq: 6 credits in literature.* Intensive study of poetic genres; major movements or periods; three or

more poets; e.g., Renaissance Epic; Augustan Poetry and Poetics; Poetry and Allegory.

Engl 568. Studies in Individual or Clustered Authors. (3-0) Cr. 3 each time taken, maximum of 6. S. *Prereq: 6 credits in literature.* Intensive study of selected authors, singly or in combination; e.g., Chaucer; Shakespeare and History; The Pre-Raphaelites; Dreiser; James and Wharton; Hurston and Walker.

Engl 569. Studies in Literary History. (3-0) Cr. 3 each time taken, maximum of 6. *Prereq: 6 credits in literature.* Intensive study of specific historical periods and issues of literary history; e.g., Age of James I; American Renaissance and the Culture Critique; Literary Radicalism of the 1930s.

Engl 572. Studies in Literary Theory and Criticism. (3-0) Cr. 3 each time taken, maximum of 6. Alt. S., offered 2001. *Prereq: 6 credits in literature; 522 or an introductory course in literary theory recommended.* Selected movements or schools of theory applied to literary texts. Focus balanced between literary and theoretical texts; e.g., Renaissance Literature and New Historicism; Feminism, Bakhtin, and the Novel; Drama, Feminism, and Performance Theory.

Engl 575. Issues in the Study of Literature. (3-0) Cr. 3 each time taken, maximum of 6. *Prereq: 6 credits in literature.* Intensive study of current and emerging topics and problems concerning literature and its relationship to theory and to language study; e.g., Theory of Metaphor; Renegotiating the Canon; Feminist Theories of the Body.

Engl 582. Studies in British Prose. (3-0) Cr. 3 each time taken, maximum of 6. S. *Prereq: 6 credits in literature.* Intensive study of three or more writers of fiction, nonfictional prose, or a combination; e.g., Origins of British Fiction; Victorian Prose; Woolf, the Bloomsbury Circle and successors.

Engl 583. Writing Manuals and Instructional Materials. (3-0) Cr. 3. S. *Prereq: 6 credits in English composition.* Application of rhetorical strategies to analysis and design of professional documents. Principles and processes for developing business and technical manuals; emphasis on application to computer documentation.

Engl 584. Editing Principles and Practices. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 507.* Principles of technical editing in business, scientific, and professional fields. Emphasis on policymaking, project management, and methodology. Both group and individual editing projects involving diverse fields, audiences, and formats.

Engl 586. Visual Communication in Professional Writing. (3-0) Cr. 3. F. *Prereq: A course in business or technical communication.* Rhetorical theory and research in graphics, document design, and related principles of visual communication. Methods of designing texts, data displays, illustrations, and other visual elements in business and technical communication.

Engl 587. Internship in Business, Technical, and Professional Writing. (3-0) Cr. 1 to 3 each time taken, maximum of 6. S. *Prereq: 507 plus 3 additional graduate credits in business and technical writing or composition and rhetoric, permission of instructor. Limited to masters and doctoral degree candidates in English.* An opportunity to write, edit, and design business and technical documents in a professional setting. Projects include reports, proposals, manuals, brochures, newsletters.

Engl 588. Supervised Practicum in Teaching English as a Second Language. (1-5) Cr. 3. F.S. *Prereq: 15 credits toward the TESL/Applied Linguistics master's degree.* Intensive observation of ESL instruction and supervised practice in teaching learners of English in a context appropriate to the practicum student's goals. Seminar discussion of observed practices in relation to language teaching theories and methods.

Engl 590. Special Topics. Cr. var. *Prereq: Permission of the Graduate Studies Committee according to guidelines available in the department office.*

- A. Literature
- B. Teaching English as a Second Language

(TESL)/Linguistics. same as Ling 590B)
C. Composition and Rhetoric
E. Rhetoric and Professional Communication
F. Creative Writing

Engl 591. Studies in Applied Linguistics. (Same as Ling 591.) (3-0) Cr. 3 each time taken, maximum of 6. *Prereq: 6 credits in TESL/linguistics.* Intensive study of applied linguistic theory as it relates to specific issues in language acquisition, teaching, or use.

Engl 592. Studies in Rhetoric and Professional Communication. (3-0) Cr. 3 each time taken, maximum of 9. *Prereq: 12 hours in rhetoric, linguistics, or literature, excluding 104/105.* Seminar on selected topics in rhetoric and professional communication or composition.

Engl 593. Workshop. Cr. arr.

Engl 599. Creative Component. Cr. 3. F.S.SS. *Prereq: Graduate classification, permission of major professor.*

Courses for Graduate Students

Engl 601. Research Methods in Rhetoric and Professional Communication. (3-0) Cr. 3. *Prereq: 6 graduate credits in English.* Survey of the major qualitative and quantitative methods used in research on writing and language in academic and nonacademic settings.

Engl 602. Research Design in Rhetoric and Professional Communication. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: 601.* A workshop for advanced graduate students in rhetoric and professional communication. Focus on qualitative and/or quantitative methods.

Engl 603. Advanced Pedagogy in Rhetoric and Composition: Theory and Research. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 503 or 504, permission of instructor.* Exploration of relationships between theory and practice in current pedagogy. Examination of poststructuralist theories and their impact on current pedagogical practice. Participation in pedagogical research and theory building.

Engl 611. Topics in the History of Rhetorical Theory. (3-0) Cr. 3 each time taken, maximum of 9. Alt. F., offered 1999. *Prereq: 547 or 548.* Rhetorical theory, criticism, and/or practice in relation to a historical period; the historical development of a rhetorical concept.

Engl 621. Seminar: Topics in Current Rhetorical Theory. (3-0) Cr. 3 each time taken. S. *Prereq: 503 or 506, permission of instructor.* Aspects of modern rhetorical theory, criticism, and practice.

Engl 699. Research. Cr. variable. F.S.SS. *Prereq: Graduate classification, permission of major professor. Research.*

Interpersonal and Rhetorical Communication (Sp Cm)

(Administered by the Department of English)

The following courses are part of the Speech Communication program. For more information, refer to that section. Sp Cm 110, 171, 212, 223, 290, 298, 305, 312, 313, 321, 322, 323, 324, 325, 327, 398, 404, 410, 412, 416, 417, 490, 493, 495A, 495B, 497, 499, 504, 513, 590.

Entomology

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Thomas C. Baker, Chair of Department

Professors: Baker, Coats, DeWitt, Hart, Krafur, Lewis, Obrycki, Pedigo, Rice, Rowley, Tollefson, Wintersteen

Professors (Collaborators): Lewis, Wilson

Professors (Emeritus): Guthrie, Lewis, Mutchmor, Stockdale

Associate Professors: Holscher

Assistant Professors: Beetham, Bonning, Courtney, Jurenka

Assistant Professors (Collaborators): Binder, Cosse, Hellmich

Undergraduate Study

For undergraduate curriculum in entomology, see *College of Agriculture, Curricula*.

The undergraduate curriculum in entomology is designed for persons interested in studying insects, their adaptations, and the practicalities of dealing with them. Students electing entomology as a major will prepare themselves for positions in industry, business, government, education, and public health.

Graduates may acquire positions in research, development, and technical sales for agricultural chemical and seed companies. State and federal agencies employ entomologists as consultants, extension directors, mosquito abatement agents, inspectors, and research aides. Entomologists may also find employment with urban or agricultural pest-management or consulting firms, large private farms and ranches, and horticultural nurseries.

All graduates understand the principles of insect structure and function. They understand the evolutionary and ecological relationships of insects with other life forms, and the impact of insects relative to human and animal health, as well as the relationships between insects and humanity's food, fiber, structural, and aesthetic needs and expectations. Graduates understand the principles and methods available to manage beneficial and pest insect populations. They are skilled in identifying insects and related groups and understand the biology, ecology, behavior, diversity, and evolutionary relationships of the major groups of insects. They understand the application of the scientific method in problem solving and the principles of experimental design and analysis. Graduates are able to communicate research and educational materials properly and competently - orally, visually, and in writing - and are able to work effectively with others.

Graduates of the agricultural and horticultural insect management option are skilled in determining pest levels and impact on plant and animal hosts, and the management of these pests. They understand the environmental, legal, and ethical issues involved in insect population management.

Graduates of the community and structural insect management option are able to combine biological, social, legal, and economic expertise to manage insects in close association with humans. They are skilled in the applications of pesticides and other management tactics for protecting human possessions from insect pest destruction. Moreover, they have an understanding of and have entrepreneurial abilities in urban and structural pest control enterprises.

Graduates of the insect biology option have achieved an understanding of the biochemical and physiological processes governing insect metabolism, growth, and form. They understand the evolutionary and ecological signifi-

cance of insects. They also have a broad background in the biological sciences. Assuming good academic performance, graduates of this option are prepared to enter graduate or professional schools.

Entomology participates in the interdepartmental undergraduate majors in plant health and protection and in integrated pest management.

The department offers a minor in entomology that may be earned by completing 370, 374, 376, and 6 credits in courses selected from an approved list supplied by the department.

A preveterinary program is available in entomology.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with a major in entomology or toxicology. Within the entomology major, the student may concentrate in aquatic entomology, biological control, chemical ecology, genetics, forest entomology, host plant resistance, medical/veterinary entomology, morphology, pathology, pest management, physiology, population ecology/genetics, systematics, or insecticide toxicology.

Graduates have a broad understanding of entomology and related disciplines, and an in-depth command of their area of concentration. They are able to communicate effectively with scientific colleagues and the general public in both formal and informal settings. Graduates are able to address complex problems facing entomology or toxicology professionals, taking into account related ethical, social, legal, economic, and environmental issues. They are skilled in research methods, data analyses, and interpretation of results. They also are skilled in working effectively with their colleagues, and writing concise and persuasive grant proposals. They have an understanding of and can critically evaluate current entomological literature.

Prerequisite to the entomology major and to minor graduate work in the department is completion of at least two years of zoological courses, for part of which credit in other closely allied biological sciences may be substituted. Specific course requirements for advanced degrees depend partly upon previous training and experience in the major field of specialization.

Any student receiving the M.S. in entomology shall have at least one course in insect physiology, one course in insect systematics, two courses of Ent 590 (selected from topics A through D, F through I, and M, inclusive), and at least 1 credit of Ent 600. Any student receiving the Ph.D. in entomology shall have at least one course in insect physiology, one course in insect systematics, four courses of Ent 590 (selected from topics A through D and F through I, inclusive), and at least 1 credit of Ent 600. In addition, Ph.D. students majoring either in Entomology or Toxicology shall have two semesters of teaching experience, taken as Ent 590K both semesters or Ent 590K one semester and Ent 590L the other semester.

Entomology participates in the interdepartmental majors in ecology and evolutionary biology, and genetics, and in the interdepartmental major and minor in toxicology (see *Index*).

The Federal Corn Insects Research Unit and the North Central Plant Introduction Station are available for advanced study in certain phases of entomological research.

More information about the department, such as current research, faculty resumes, physical facilities, and graduate students can be viewed on the department's world-wide web page.

Courses open for nonmajor graduate credit: 370, 373, 374, 376, 416, 483.

Courses Primarily for Undergraduate Students

Ent 110. Technical Lecture. (1-0) Cr. R. F. Hart. Orientation to areas of and opportunities in entomology.

Ent 201. Introduction to Insects. (1-0) Cr. 1. F.S.SS. 5 weeks. S. Classroom section spring only. World Wide Web section of course offered all semesters. Obrycki. Biological and ecological aspects of insects.

Ent 211. Insects and Society. (3-0) Cr. 2. F.S.SS. 11 weeks. S. Classroom section spring only. World Wide Web section offered all semesters. *Prereq:* 201. Obrycki. The importance of insects in human well-being. Insect-human interactions. Primarily for nonscience and nonagriculture majors.

Ent 212. Livestock Entomology. (3-0) Cr. 1. S. 5 weeks. *Prereq:* 201. Holscher. Overview of the biology, ecology, and economic importance of the insects that affect livestock production.

Ent 213. Management of Structural Insect Pests. (3-0) Cr. 1. F. 5 weeks. *Prereq:* 201. Lewis. Recognition, biology, economic importance and management of insects and other arthropods that infest homes and commercial structures with an emphasis on structural, household, and stored product pests.

Ent 214. Ecologically-based Management of Horticultural Pests. (3-0) Cr. 1. F. 5 weeks. *Prereq:* 201 or permission of instructor. Obrycki. Overview of ecologically-based management of pest and beneficial insects in horticultural crops.

Ent 283. Pesticide Applicator Certification. (Same as Agron 283, For 283, Hort 283, PI HP 283, P M 283.) (2-0) Cr. 2. S. Pedigo. Core background and specialty topics in agricultural, forestry, and horticultural pesticide applicator certification. Students select certification categories and are eligible for pesticide applicator certification upon completion of course. Commercial certification emphasized.

Ent 360. Insect Behavior. (Dual-listed with 560.) (3-0) Cr. 3. S. *Prereq:* Biol 202. Baker. The mechanisms underlying the behavior of insects; emphasis on neuroethological and evolutionary bases of insect orientation, reproduction, feeding, oviposition, defense, learning, and sociality.

Ent 370. Insect Biology. (Same as Biol 370.) (2-3) Cr. 3. F. *Prereq:* Biol 109 or 201. Hart. Structure, physiology, evolution, behavior, life histories, and recognition of insects. Collection required. Voluntary field trips. Nonmajor graduate credit.

Ent 371I. Introduction to Insect Ecology. (Same as la LL 371I.) See *Iowa Lakeside Laboratory*.

Ent 373. Household and Structural Pest Management. (3-0) Cr. 3. S. *Prereq:* Biol 109 or 201; Ent 201. Lewis. Principles of pest management for household, structural and stored product pests. Recognition, biology, and significance of insects, other arthropods, and major pest vertebrates that infest homes and commercial structures. Tactics of pest prevention, suppression, and elimination.

Ent 374. Insects and Our Health. (Same as Biol 374, Micro 374.) (3-0) Cr. 3. S. *Prereq:* 3 credits in biological sciences. Rowley. Identification, biology, and sig-

nificance of insects and arthropods that attack people and animals, particularly those that are vectors of disease. Nonmajor graduate credit.

Ent 375. Plant Protection Using Natural Enemies. (Dual-listed with 575.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 370 or 376 or permission of instructor. Bonning and Obyrcki. Overview of the biology, ecology, and classification of insect pathogens, predators, and parasitoids. Discussion of the use of these organisms in plant protection, including an emphasis on genetic alteration of natural enemies.

Ent 376. Fundamentals of Entomology and Pest Management. (Same as P M 376 and PI HP 376.) (2-3) Cr. 3. F.S. *Prereq:* Biol 109 or 201. Pedigo. Introduction to entomology and insect-pest management, including life processes, ecology, economics, tactics of population suppression, and ecological backlash. Nonmajor graduate credit.

Ent 416. Forest Pest Management. (Same as PI P 416, For 416, PI HP 416, P M 416.) (3-1) Cr. 4. S. *Prereq:* 8 credits in biological sciences, including Biol 201. Harrington, Hart. Nature of forest, shade tree, and wood pests; physical agents of tree damage; concepts of forest health; integrated case studies in the evaluation and economic analysis of protection and pest management problems; weekend field trip. Field trip fee. Nonmajor graduate credit.

Ent 425. Aquatic Insects. (Dual-listed with 525; same as A Ecl 425.) (2-3) Cr. 3. Alt. S., offered 2001. *Prereq:* Biol 312 or equivalent. Courtney. Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

Ent 452. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 552; same as PI P 452, Hort 452.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* Hort 351. Gleason, Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Ent. 483. Wood Deterioration and Preservation. (Same as For 483, PI P 483.) See *Forestry*. Nonmajor graduate credit.

Ent 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq:* 15 credits in biological sciences, junior or senior classification, permission of instructor. A maximum of 6 credits of 490 may be used toward the total of 128 credits required for graduation.
E. Research or work experience.
U. Laboratory teaching experience. For students registering to be undergraduate laboratory assistants.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Ent 525. Aquatic Insects. (Dual-listed with 425; same as A Ecl 525.) (2-3) Cr. 3. Alt. S., offered 2001. *Prereq:* Biol 312 or equivalent. Courtney. Morphology, ecology, diversity and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

Ent 550. Pesticides in the Environment. (Same as Tox 550.) (2-0) Cr. 2. S. *Prereq:* Graduate classification or permission of instructor. Coats. Fate and significance of pesticides in soil, water, plants, animals, and the atmosphere.

Ent 552. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 452; same as PI P 552, Hort 552.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* Hort 351. Gleason, Lewis. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

Ent 555. Insect Physiology. (3-3) Cr. 4. S. *Prereq:* 370. Jurenka. Life processes of the insects, including reviews of current problems in insect physiology.

Ent 560. Insect Behavior. (Dual-listed with 360.) (3-0) Cr. 3. S. *Prereq:* Biol 202. Baker. The mechanisms underlying the behavior of insects; emphasis

on neuroethological and evolutionary bases of insect orientation, reproduction, feeding, oviposition, defense, learning, and sociality.

Ent 570. Host Plant Resistance to Insects. (2-0) Cr. 2. Alt. S., offered 2000. *Prereq:* 370 or 376. Tollefson. Principles of insect and host interactions and mechanisms of insect control by host plant resistance.

Ent 572. Insect Morphology and Evolution. (2-3) Cr. 3. Alt. F., offered 1999. *Prereq:* 15 credits in zoological sciences, including 370. Krafur. The functional anatomy and ultrastructure of insects and other arthropods, with emphasis on adaptation and evolutionary significance.

Ent 573. Advanced Insect Pest Management. (3-3) Cr. 4. Alt. F., offered 1999. *Prereq:* 370. Tollefson. Contemporary concepts of insect biology and applications of insect population management.

Ent 574. Medical Entomology. (3-3) Cr. 4. Alt. S., offered 2000. *Prereq:* 9 credits in biological sciences. Rowley. Identification, biology, and significance of insects and other arthropods that attack people and animals, particularly those that are vectors of disease.

Ent 575. Plant Protection Using Natural Enemies. (Dual-listed with 375.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 370 or 376 or permission of instructor. Bonning and Obyrcki. Overview of the biology, ecology, and classification of insect pathogens, predators, and parasitoids. Discussion of the use of these organisms in plant protection, including an emphasis on genetic alteration of natural enemies.

Ent 576. Systematic Entomology. (3-6) Cr. 5. F. *Prereq:* 370. Courtney. Classification, distribution, and natural history of insects, including fundamentals of phylogenetic systematics, biogeography, taxonomic procedures, and insect collection and curation.

Ent 580. Sustainable Agriculture Seminar. (Same as An S 580.) See *Animal Science*.

Ent 590. Special Topics. Cr. 1 to 3 each time taken. *Prereq:* 15 credits in zoological sciences, permission of instructor.

- A. Biological Control and Pathology.
- B. Chemical Ecology and Behavior.
- C. Ecology and Pest Management.
- D. Evolution and Systematics.
- E. Special Research Topics.
- F. Medical and Veterinary Entomology.
- G. Molecular Entomology.
- H. Morphology and Physiology.
- I. Toxicology and Biochemistry.
- K. Teaching Experience.
- L. Extension Internship.
- M. Immature Insects.

Courses for Graduate Students

Ent 600. Seminar. Cr. 1. F.S. *Prereq:* Permission of instructor. Presentation of research results.

Ent 605. Theory and Practice of Biological Control. (2-3) Cr. 3. Alt. F., offered 2000. *Prereq:* 375 or 575 or permission of instructor. Obyrcki. The underlying ecological, physiological, and genetic basis of biological control. Review of case histories.

Ent 610. Insect Genetics. (2-3) Cr. 3. Alt. S., offered 2001. *Prereq:* 370, 15 credits in biological sciences, and one course in genetics. Krafur. Major genetic systems among the insects. Population genetics and principles and methods of genetic manipulation of arthropod populations for economic and public health benefit. Review of case histories. Laboratory includes molecular methods of measuring variation.

Ent 671. Insect Ecology. (2-3) Cr. 3. Alt. F., offered 2000. *Prereq:* 370, Biol 312, Stat 401. Pedigo. Concepts of insect population dynamics, emphasizing sampling, outbreaks, analysis, and bioeconomics.

Ent 673. Insect Pathology. (3-3) Cr. 4. Alt. S., offered 2001. *Prereq:* 375 or 575 or permission of instructor. Bonning. Principles of insect pathology and microbiology, including genetic engineering of entomopathogens for insect pest control.

Ent 674. Advanced Medical Entomology. (1-6) Cr. 3. Alt. F., offered 1999. *Prereq:* 574. Rowley.

Vector-parasite relationships, ecology, and epidemiology of arthropod-borne animal diseases.

Ent 675. Insecticide Toxicology. (Same as Tox 675.) (2-3) Cr. 3. Alt. F., offered 2000. *Prereq:* 555 or Tox 501 or permission of instructor. Coats. Principles of insecticide toxicology; classification, mode of action, metabolism, and environmental effects of insecticides.

Ent 699. Research. Cr. var.

Entrepreneurial Studies

(Interdepartmental Undergraduate Minor)

Supervisory Committee: J. David Hunger (Business), Chair; D. Draper (Vet Med); Eric O. Hoiberg (Ag); Loren W. Zachary (Engineering); Mary A. Littrell (Family & Cons. Science); Mark J. Chidister (Design); Zora D. Zimmerman (LAS); Roger A. Smith (Education).

Entrepreneurial Studies is an interdisciplinary program that provides opportunities to students to learn about entrepreneurship—the starting of new business ventures. It serves to complement the student's major area of study, whether it be electrical engineering, horticulture, textiles and clothing, or veterinary medicine, by offering a means of putting theory and science into practice. The goal of the Entrepreneurial Studies program is to provide the knowledge and skills needed to start and manage new ventures. In addition to feasibility analysis and business planning, the program deals with the topics of innovation, technology transfer, industry analysis, and competitive strategy. Although the program introduces some fundamental concepts from accounting, finance, marketing, and management, it does not attempt to substitute for any business courses in these areas.

A minor in entrepreneurial studies is currently available to undergraduate students who are not enrolled in the College of Business. (Students majoring in the College of Business may major or minor in Management with an option in Entrepreneurship and Strategy and are thus not eligible for the entrepreneurial studies minor.) Students must follow college specific rules in selecting courses and must consult with the representative of that college to the Entrepreneurial Studies Supervisory Committee. The college representatives to the supervisory committee will be responsible for advising students in their college, and will inform students about the details of the college rules.

Minor

A student seeking a minor in entrepreneurial studies must successfully complete a minimum of 15 credits in courses approved for use in the entrepreneurial studies program, including the two required courses, Management 310 and 313. Management 310, *Entrepreneurship and Innovation*, is the introductory course and provides an overview of the entire field. Management 313, *Feasibility Analysis and Business Planning*, serves as the capstone course through its emphasis on developing an idea for a new venture, con-

ducting a feasibility study, researching the potential market, analyzing the competition, and preparing a formal business plan. Up to six of the 15 credits required for the minor may also be used in the student's required program of study. Interested students should see a representative of the Entrepreneurial Studies Supervisory Committee in the college of their primary major for the list of approved courses.

Environmental Science

(Interdepartmental Undergraduate Program)

William G. Crumpton: Coordinator

Environmental Science provides an integrated, quantitative, and interdisciplinary approach to the study of environmental systems. The magnitude and complexity of environmental problems are creating a growing need for scientists with rigorous, interdisciplinary training in environmental science. The Environmental Science curriculum is designed to prepare students for positions of leadership in this rapidly changing discipline. Environmental Science graduates have a solid foundation in biological and physical natural sciences and the specialized training necessary for integrated analysis of environmental systems. Scientific rigor is stressed throughout the program, beginning with the foundation courses in the first two years of the curriculum. The upper level core courses emphasize a dynamic systems approach that provides a framework for integrating physical, chemical, and biological aspects of environmental systems.

The Environmental Science major is offered through both the College of Agriculture and the College of Liberal Arts and Sciences. Environmental Science majors complete foundation courses in biology, chemistry, earth science, geology, physics and mathematics, plus a major consisting of an integrated core of Environmental Science courses and additional advanced course work in Environmental Science. General requirements for the major are outlined below, and additional information is available in the Environmental Programs Office, 131 Bessey Hall.

Students seeking an Environmental Science major complete the following:

(1) A foundation of approved supporting courses in science and mathematics including biology, chemistry, earth science, physics, calculus, and statistics, (2) Thirty credits of course work in the major, including the Environmental Science core (EnSci 101, 295, 330, 401, 402, 404/404L, and 495) and 12 additional credits of approved course work in Environmental Science. A combined average grade of C or higher is required in courses applied in the major. (3) Practical experience consisting of EnSci 290, 390, or equivalent experience.

English proficiency requirement: Beyond first-year composition (Engl 104 and 105) Environmental Science majors must demonstrate proficiency in written communication by

1999-2001

completing an approved advanced course and maintaining a portfolio of term papers and other major writing assignments for departmental evaluation.

A minor in Environmental Science may be earned by completing 15 credits in Environmental Science including EnSci 330 and at least 7 credits from EnSci 401, 402, and 404.

Courses open for nonmajor graduate credit: 301, 330, 401, 402, 402I, 404, 404L, 410, 410L, 411, 422, 422I, 434, 473, 473I, 475, 485, 487.

Courses Primarily for Undergraduate Students

EnSci 101. Orientation to Environmental Science. (1-0) Cr. R. F. First 8 weeks. *Prereq: Freshman classification in Environmental Science.* Staff. Overview of the Environmental Science curriculum and issues to consider in planning a program of study. Required of first year Environmental Science majors. Offered on a satisfactory-fail grading basis only.

EnSci 290. Apprenticeship. Cr. Var. Staff. *Prereq: Approval of the Environmental Science Coordinator.* Practical experience in and approved setting such as a research laboratory, government office, or private office. This should be completed prior to being classified as a senior or completing EnSci 390. Offered on a satisfactory-fail grading basis only.

EnSci 295. Sophomore Seminar. (1-0) Cr. R. F. Burras. *Prereq: Sophomore classification in EnSci.* Discussion of current issues in Environmental Science. Field trip. Offered on a satisfactory-fail grading basis only.

EnSci 301. Forest Ecology. (Same as For 301.) See *Forestry.* Nonmajor graduate credit.

EnSci 312. Ecology. (Same as Biol 312.) See *Biology.*

EnSci 330. Environmental Systems. (Same as Bot 330, Env S 330.) (2-4) Cr. 4. F. *Prereq: Biol 202 or Micro 201, Chem 164 or 178, Math 165 or 181.* Crumpton. Dynamics of natural environmental systems. Systems approach to the analysis of material and energy flows, including physical and biological aspects of environmental systems and their functional connections. Laboratory emphasizes environmental modeling and simulation. Nonmajor graduate credit.

EnSci 360. Environmental Soil Science. (Same as Agron 360.) (2-3) Cr. 3. S. *Prereq: Agron 260 or Geol 100 or 201.* Burras. Application of soil science to contemporary environmental problems; comparison of the impacts that different management strategies have on short-and long-term environmental quality and land development. Emphasis on participatory learning activities.

EnSci 390. Internship in Environmental Science. Cr. var. *Prereq: Approval of the Environmental Science coordinator.* Supervised off-campus work experience in the field of environmental science. Offered on a satisfactory-fail grading basis only.

EnSci 401. Environmental Biogeochemistry. (Same as Bot 401, Geol 401.) (3-2) Cr. 4. S. *Prereq: EnSci 330 or permission of the instructor.* Hoyle and Raich. Biological, chemical, and physical phenomena controlling material, energy, and elemental fluxes in the environment. Nonmajor graduate credit.

EnSci 402. Watershed Hydrology and Surficial Processes. (Same as Agron 402, For 402, Geol 402.) (3-3) Cr. 4. F. *Prereq: Credit or enrollment in EnSci 330 or Geol 100 or 201, Phys 111, 3 credits in biology and 6 credits in chemistry.* Burras, Schultz, Simpkins. Examination of watersheds as systems wherein biological and physical factors control hydrology, soil formation, and nutrient transport. Laboratory emphasizes field investigation of watershed-scale processes. Nonmajor graduate credit.

EnSci 404. Global Change. (Same as Agron 404, Env S 404, Mteor 404.) (3-0) Cr. 3. S. *Prereq: Four*

courses in physical or biological sciences or engineering, concurrent enrollment in EnSci 404L. Takle. Biogeochemical cycles, ozone chemistry, global energy balance, structure and circulation of the atmosphere and oceans, climate modeling, climate variability; and implications for agriculture, water resources, energy use, sustainable development and public policy. Human dimensions and ethical issues of global environmental change. Nonmajor graduate credit.

EnSci 404L. Global Change Laboratory. (0-2) Cr. 1. S. *Prereq: Math 182 or 266, concurrent enrollment in EnSci 404.* Takle. Laboratory develops quantitative applications and examples of lecture topics using global data sets, models, and budgets of energy, mass, and chemical constituents. Nonmajor graduate credit.

EnSci 410. Aquatic Ecology. (Same as A Ecl 410.) See *Animal Ecology.* Nonmajor graduate credit.

EnSci 410L. Aquatic Ecology Laboratory. (Same as A Ecl 410L.) See *Animal Ecology.* Nonmajor graduate credit.

EnSci 411. Hydrogeology. (Same as Geol 411.) (3-2) Cr. 4. F. *Prereq: Geol 100 or 201; Math 165 or 181; Phys 111 or 221.* Simpkins. Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, and groundwater geochemistry. Introduction to groundwater flow modeling. Lab emphasizes applied field and laboratory methods for hydrogeological investigations. Field trip fee. Nonmajor graduate credit.

EnSci 422. Environmental Geochemistry. (Same as Geol 422.) (2-2) Cr. 3. F. *Prereq: 402 or 411, Chem 178 or equivalent background in chemistry.* Hoyle. Geochemistry of natural waters, including inorganic and organic constituents and water-rock interactions. Interpretation of water quality data. Geochemical equilibrium modeling and introduction to kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling. Materials fee. Nonmajor graduate credit.

EnSci 434. Contaminant Hydrogeology. (Same as Geol 434.) (3-0) Cr. 3. S. *Prereq: 411 and 422 or their equivalent.* Hoyle. Brief review of organic and inorganic contaminants in industrial and agricultural settings. Process-oriented approach to abiotic and biological fate and transport of contaminants. Investigation of coupled processes (dispersion, diffusion, advection, sorption, biodegradation) using computer models. Remediation strategies. Nonmajor graduate credit.

EnSci 459. Environmental Soil Chemistry. (Same as Agron 459.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: 401 or Agron 354, Chem 210 or 211.* An introduction to the chemical properties of soils, chemical reactions and transformations occurring in the soils and their impact on the environment. Topics include composition of soils, acid-base equilibria, buffer systems, mineral dissolution and precipitation, speciation, ion exchange, redox reactions, adsorption phenomena, soil pollution and chemical-equilibria computer programs.

EnSci 473. Soil Genesis and Landscape Relationships. (Same as Agron 473.) (2-3) Cr. 4. S. *Prereq: 402 or Agron 154 or 402.* Sandor. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Field trip fee. Credit for 473 or 473I may be applied for graduation, not both. Nonmajor graduate credit.

EnSci 475. Surficial Processes. (Same as Geol 475.) (2-2) Cr. 3. *Prereq: Geol 100 or 201 or equivalent experience.* Study of surficial processes in modern and ancient geological environments. Topics include weathering, sediment transport, and landform hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory emphasizes aerial photo and topographic map interpretation. Field trip fee. Nonmajor graduate credit.

EnSci 485. Soil Microbial Ecology. (Same as Agron 485.) (2-3) Cr. 3. F. *Prereq: Agron 154, Micro 201 (Micro 203 recommended).* Loynachan. The living organisms in the soil and what they do. Emphasis on

soil-plant-microbial relationships and environmental issues. Nonmajor graduate credit.

EnSci 487. Aquatic and Wetland Microbial Ecology. (Same as Bot 487.) (3-0) Cr. 3. S. *Prereq:* 6 credits in biology and 6 credits in chemistry. Crumpton. Introduction to major functional groups of autotrophic and heterotrophic microorganisms and their roles in aquatic and wetland ecosystems. Emphasis on energy flow and nutrient dynamics. Nonmajor graduate credit.

EnSci 490. Independent Study. Cr. Var. *Prereq:* Permission of the instructor and approval of the Environmental Science coordinator.

EnSci 495. Integrated Case Studies. (1-3) Cr. 2. S. *Prereq:* Senior classification in Environmental Science. Schultz. Integrated approach to the analysis and management of environmental systems. The course will focus on cooperative group activities to identify and assess environmental problems in heavily impacted landscapes and to develop and evaluate alternative management plans Field trips.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

EnSci 513. Ecological Toxicology. (Same as A Ecl 513.) See *Animal Ecology*.

EnSci 518. Stream Ecology. (Same as A Ecl 518.) See *Animal Ecology*.

EnSci 544. Aquatic Toxicology. (Same as A Ecl 544.) See *Animal Ecology*.

EnSci 552. Restoration Ecology. (Same as A Ecl 552.) See *Animal Ecology*.

EnSci 564. Wetland Ecology. (Same as Bot 564.) See *Botany*.

EnSci 584. Ecosystem Ecology. (Same as Bot 584.) See *Botany*.

Courses Offered at the Iowa Lakeside Laboratory

EnSci 304I. Environmental Geology of Northwest Iowa. (Same as Ia LL 304I.) See *Iowa Lakeside Laboratory*.

EnSci 312I. Ecology. (Same as Ia LL 312I.) See *Iowa Lakeside Laboratory*.

EnSci 402I. Watershed Hydrology and Surficial Processes. (Same as Ia LL 402I.) See *Iowa Lakeside Laboratory*.

EnSci 422I. Prairie Ecology. (Same as Ia LL 422I.) See *Iowa Lakeside Laboratory*.

EnSci 473I. Soil Genesis and Landscape Relationships. (Same as Ia LL 473I.) See *Iowa Lakeside Laboratory*.

EnSci 508I. Aquatic Ecology. (Same as Ia LL 508I.) See *Iowa Lakeside Laboratory*.

EnSci 560I. Restoration Ecology. (Same as Ia LL 560I.) See *Iowa Lakeside Laboratory*.

EnSci 564I. Wetland Ecology. (Same as Ia LL 564I.) See *Iowa Lakeside Laboratory*.

Environmental Studies

(Interdepartmental Undergraduate Program)

William G. Crumpton: Coordinator

The Environmental Studies Program deals with the relationship between humans and nature, or between humans and natural systems. The curriculum is designed to give students an understanding of regional and global environmental issues and an appreciation of different perspectives regarding these issues.

Courses are provided for students pursuing careers related to the environment and for others who simply want to know more about environmental issues. In addition, students in any college may elect to take a secondary major or minor in Environmental Studies. Additional information is available in the Environmental Programs Office, 131 Bessey Hall.

Secondary Major

The Environmental Studies secondary major is taken in addition to one's first major and provides the breadth of preparation and integrated perspective necessary to understand environmental issues. Regardless of their home college, students seeking a secondary major in Environmental Studies complete 24 credits of approved course work including (1) Env S 120 or 201, and 303, (2) at least two integrative/issues courses chosen from Env S 324, 340, 345, 404, 424, and 450, and (3) at least three human/societal perspectives courses chosen from Env S 334, 380, 382, 425, 472, 482, and 491. Beyond these three requirements, any Environmental Studies course or approved departmental course may be applied toward the 24 credit total for the major. A list of approved departmental courses is available in the Environmental Programs Office. Environmental Studies majors must take 12-18 credits of approved course work in natural science which may include some courses used in the 24 credits for the major. Some courses used in the major may also be used to satisfy general education and other requirements of departments and colleges, but at least 15 credits of course work must be unique to the major (i.e. not used to meet any other department, college, or university requirement). A combined average grade of C or higher is required in courses applied to the major.

Minor

Students seeking a minor in Environmental Studies complete 15 credits in Environmental Studies courses including (1) Env S 120 or 201, and 303, (2) at least one integrative/issues course chosen from Env S 324, 340, 345, 404, 424, and 450, and (3) at least one human/societal perspectives course chosen from Env S 334, 380, 382, 425, 472, 482, and 491. Beyond these three requirements, any Environmental Studies course may be applied toward the 15 credit total for the minor. A combined average grade of C or higher is required in courses applied to the minor, and the minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

Courses open for nonmajor graduate credit: 303, 330, 334, 404, 407, 415, 421, 425, 472, 480I, 482.

Courses Primarily for Undergraduate Students

Env S 101. Environmental Geology: Earth in Crisis. (Same as Geol 101.) (3-0) Cr. 3 or (3-1) Cr. 4. F. S. Cody, Seifert. An introduction to geologic processes and the consequences of human activity from local to global scales. Discussion of human population growth, resource depletion, pollution and waste disposal, global warming and ozone depletion, desertification, and geologic hazards such as earthquakes, landslides, flooding, and volcanism. Students

who enroll for the 4 credit option must register for a one hour discussion section.

Env S 120. Introduction to Renewable Resources. (Same as A Ecl 120.) (3-0) Cr. 3. F. S. Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

Env S 123. Environmental Biology. (Same as Biol 123.) (3-0) Cr. 3. F. S. An introduction to the structure and function of natural systems at scales from the individual to the biosphere and the complex interactions between humans and their environment. Discussions of human population growth, biodiversity, sustainability, resource use, and pollution.

Env S 201. Introduction to Environmental Issues. (4-0) Cr. 2. F. S. First 8 weeks. *Prereq:* *Sophomore classification*. Ecological and human/societal dimensions of environmental issues; how humans and their institutions interact with and affect the environment; how societies are affected by environmental change. Selected issues such as human population growth, loss of biodiversity, and effects of agriculture on the environment.

Env S 293. Environmental Planning. (Same as C R P 293.) (3-0) Cr. 3. F. *Prereq:* *Sophomore classification*. Comprehensive overview of the field of environmental relationships and the efforts being made to organize, control, and coordinate environmental, aesthetic, and cultural characteristics of land, air, and water.

Env S 303. Great Environmental Writings. (4-0) Cr. 2. F. S. Second 8 weeks. Tanner. Students will read works by such authors as Thoreau, Muir, Leopold, and Abbey. Nonmajor graduate credit.

Env S 324. Energy and the Environment. (4-0) Cr. 2. F. S. Second 8 weeks. *Prereq:* 201. Hodges. Renewable and non-renewable energy resources. Fossil fuels, nuclear energy, solar energy, and energy efficiency. Air pollution, acid precipitation, global climate change; their causes and remedies.

Env S 330. Environmental Systems. (Same as Bot 330, EnSci 330.) (2-4) Cr. 4. F. *Prereq:* *Biol 202 or Micro 201, Chem 164 or 178, Math 165 or 181*. Crumpton. Dynamics of natural environmental systems. Systems approach to the analysis of material and energy flows, including physical and biological aspects of environmental systems and their functional connections. Laboratory emphasizes environmental modeling and simulation. Nonmajor graduate credit.

Env S 334. Environmental Ethics. (Same as Phil 334.) (3-0) Cr. 3. F. *Prereq:* *Three credits in philosophy or junior classification*. Thorough study of some of the central moral issues arising in connection with human impact on the environment, e.g., human overpopulation, species extinction, forest and wilderness management, pollution. Several world views of the proper relationship between human beings and nature will be explored. Nonmajor graduate credit.

Env S 340. Biodiversity. (Same as Bot 340.) (4-0) Cr. 2. S. Second 8 weeks. *Prereq:* *One course in natural sciences or Environmental Studies*. Clark. Survey of the major groups of organisms and biological systems. Definition, measurement, and patterns of distribution of organisms. Sources of information about biodiversity. Not intended for major credit in the biological sciences.

Env S 345. Population Problems and Society. (Same as Soc 345.) (3-0) Cr. 3. F. *Prereq:* *Soc 130 or 134*. Human overpopulation; impact on food, resources, and services; population growth and development; trends of births, deaths, and geographic movement; projecting future population; population control and family planning; population policies and laws; comparison of the United States with other societies throughout the world..

Env S 380. Environmental and Resource Economics. (Same as Econ 380.) (3-0) Cr. 3. F. S. *Prereq:* *Econ 101*. Natural resource availability, use, conservation, and government policy, including energy issues. Environmental quality and pollution control policies.

Env S 382. Environmental Sociology. (Same as Soc 382.) (3-0) Cr. 3. F. S. Environmental quantity and quality as social problems; value orientations toward nature; environmental quality movement; institutional patterns affecting use of natural resources; resource management issues.

Env S 390. Internship in Environmental Studies. Cr. var. *Prereq:* *Approval of the Environmental Studies Coordinator.* Practical experience with nature centers, government agencies, schools, private conservation groups, and other organizations. Offered on a satisfactory-fail grading basis only.

Env S 404. Global Change. (Same as Agron 404, EnSci 404, Mteor 404.) (3-0) Cr. 3. S. *Prereq:* *Four courses in physical or biological sciences or engineering.* Tackle. Biogeochemical cycles, ozone chemistry, global energy balance, structure and circulation of the atmosphere and oceans, climate modeling, climate variability; and implications for agriculture, water resources, energy use, sustainable development and public policy. Human dimensions and ethical issues of global environmental change. Nonmajor graduate credit.

Env S 407. Watershed Management. (Same as For 407.) (3-3) Cr. 4. S. *Prereq:* *A course in general biology.* Managing human impacts on the hydrologic cycle. Field and watershed landscape best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers. Field trip fee. Nonmajor graduate credit.

Env S 415. Environmental Studies Seminar. (1-0) Cr. 1 each time taken. Offered on an irregular basis. *Prereq:* *Junior classification.* Current or historic topics in Environmental Studies. Nonmajor graduate credit.

Env S 421. Field Seminar. (0-6) Cr. 1 to 2. Offered on an irregular basis. Field trips during semester or break to varied sites of environmental interest in or outside of Iowa, preceded by readings, lectures, and examinations about the areas to be visited. Focus on development vs. preservation. Field trip fee. Nonmajor graduate credit.

Env S 424. Sustainable and Environmental Horticulture Systems. (Same as Hort 424.) (2-0) Cr. 2. S. Inquiry into ethical issues and environmental consequences of horticultural cropping systems and production practices. Emphasis on production systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

Env S 425. Sociopolitical Analysis of Environmental Issues. (3-0) Cr. 3. F. *Prereq:* *201 and one other Environmental Studies course.* Institutional behaviors which underlie environmental problems and controversies here and overseas. The roles of government, business, citizen activists, the press, international development banks, and others. Nonmajor graduate credit.

Env S 450. Issues in Sustainable Agriculture. (Same as Agron 450.) (2-0) Cr. 2. F. Salvador. Agricultural science as a human activity; contemporary agricultural issues from agroecological perspective. Comparative analysis of intended and actual consequences of development of industrial agricultural practices. Field trip fee.

Env S 472. American Environmental History. (Same as Hist 472.) (3-0) Cr. 3. F. *Prereq:* *Sophomore classification.* Taylor. Conceptual approach to human history in North America by examining the impact of nature from precontact through the 20th century. Explores material interactions; intellectual modes; aesthetic relationships; and management strategies from aboriginal society through the environmental age. Nonmajor graduate credit.

Env S 480I. Landscape Approaches to Environmental Planning. (Same as la LL 480I.) See *Iowa Lakeside Laboratory.* Nonmajor graduate credit.

Env S 482. Environmental Politics and Policies. (Same as Pol S 482.) (3-0) Cr. 3. F. *Prereq:* *3 credits in political science or 3 credits in Environmental Studies; junior classification.* Major ideologies relating to conservation and ecology. Primary emphasis on the policy making process in U.S. national and state governments, with principal application to envi-

ronmental and land-use policies. Major proposals for improvement in policy content and process. Nonmajor graduate credit.

Env S 484. Sustainable Communities. (Same as C R P 484.) (3-0) Cr. 3. F. *Prereq:* *Senior status or permission of instructor.* This course provides the opportunity to explore both the theoretical construction of sustainability and its application to physical and social planning of communities. We will examine environmental ethics as a basis for sustainability, the history of the idea itself, and the movement toward indicators as outcome measurements both in the U.S. and internationally. We then explore how these ideas have been applied in communities here and abroad.

Env S 490. Independent Study. Cr. var. *Prereq:* *Permission of instructor and approval of Environmental Studies coordinator.*

Env S 491. Environmental Law. (Same as C R P 491.) (3-0) Cr. 3. S. *Prereq:* *6 credits in natural sciences.* Legal precedents and alternative policies for environmental protection; rights to and regulations for uses of water, air, and land. Federal environmental control acts and leading federal court cases. Field trip.

Family and Consumer Sciences

Master of Family and Consumer Sciences (M.F.C.S.).

The College of Family and Consumer Sciences offers a 36 credit program designed to enhance the skills of those holding the bachelor's degree so that they may meet the requirements of their present jobs or progress in their careers. The program is considered to be a professional master's degree and not preparation for further graduate study.

Graduates understand, interpret and evaluate the research literature in family and consumer sciences. They communicate and conceptualize family and consumer sciences content from an integrative and holistic perspective. Graduates apply theory and research to practice in serving individuals, families, and communities through professional family and consumer sciences roles.

Students elect either a comprehensive option or a specialization option. The comprehensive option can be followed on or off-campus and requires 36 credits covering a variety of family and consumer sciences subject matter. Off-campus courses are offered at several locations via the Iowa Communications Network (ICN). The specialization option is offered on-campus only, from the following departments: Hotel, Restaurant, and Institution Management; Human Development and Family Studies; and Textiles and Clothing.

A written and oral final integrative exam are required in lieu of a thesis or creative component, although a thesis or creative component could be included on mutual agreement of the student and major professor, with approval of the Graduate College.

The program of study committee, in consultation with the student, determines the courses to be taken and the acceptability of transfer

credits. The major professor will be selected from the discipline where the concentration of coursework will be taken.

Admission for the comprehensive option includes a bachelor's degree in a family and consumer sciences/home economics subject area or related discipline, Graduate Record Examination scores, official transcripts, three letters of recommendation, a goal statement, graduation in the upper one-half of class with a bachelor's degree from a regionally accredited U.S. institution or graduation in the upper one-half of class from a recognized foreign institution. Non-English speaking international students are required to have a TOEFL score of at least 550 at time of admission.

Admission requirements for the specialization option vary by department.

For additional information, students should contact the Research and Graduate Education Office, 126 MacKay Hall, Ames, Iowa 50011: mfcinfo@iastate.edu

Family and Consumer Sciences Education and Studies

Rosalie J. Amos, Chair of Department

Professors: Brun, Cowan, Williams

Professors (Adjunct): Kurth

Distinguished Professors (Emeritus): Fanslow, Moyer

Professors (Emeritus): Anderson, Beavers, Crabtree, Elliott, Smith

Associate Professors: Amos, Hausafus, Torrie

Associate Professors (Adjunct): Albright

Associate Professors (Emeritus): Ebert

Assistant Professors: Vail

Assistant Professors (Adjunct): Kruempel, Shirer

Instructors (Adjunct): Butterbaugh, Warning

Undergraduate Study

For undergraduate curricula in family and consumer sciences education and studies leading to the degree bachelor of science, see *Family and Consumer Sciences Education and Studies*.

The department offers one curriculum for the bachelor of science degree in Family and Consumer Sciences Education and Studies. Students in the curriculum choose one of two primary options, Education or Studies. Graduates of the primary option, Education, develop, implement, and evaluate family and consumer sciences programs for intended audiences in a variety of educational settings. Graduates of the primary option, Studies, apply integrative knowledge of family and consumer sciences in diverse careers for domestic and international settings.

For the chosen primary option, a secondary option also must be selected. In Education, the choice is either Teacher Licensure or Educational Services; for Studies, the choice is either International or General. The Teacher Licensure secondary option in Education prepares students for licensure to teach in general, vocational, and occupational programs of family and consumer sciences in middle, junior, and senior high schools. The Educational Services secondary option in Education prepares students for careers as educators in settings such as Cooperative Extension, business, community agencies, community colleges, and public school adult education. In Studies, the International secondary option prepares students for working professionally in international settings or with international audiences in the U.S. The General option in Studies enables students to pursue individualized career goals in family and consumer sciences.

Admission to all four options is initiated in the course FCEdS 206. In addition, students in Teacher Licensure follow department and university procedures for admission to the university teacher education program. This program option is approved by the Iowa Department of Education for the preparation of vocational family and consumer sciences teachers. For additional teacher education requirements, see *College of Education*.

Graduates in Family and Consumer Sciences Education and Studies have a broad understanding of individual and family well-being. Graduates apply knowledge of family and consumer sciences content in domestic and/or international professional settings. They use research findings to improve the well-being of individuals, families, and communities. Due to the integrative and synergistic nature of family and consumer sciences, graduates address and act on complex problems confronting individuals, families, and communities.

Opportunities are available for obtaining a minor from other departments through careful selection of elective credits and consultation with an adviser. For example, students pursuing the Educational Services and General options are encouraged to consider obtaining a minor in journalism and mass communications or in one of the subject matter areas of family and consumer sciences such as resource management and consumer sciences or housing and the near environment. They also are encouraged to enhance their program by electing additional courses in an area of business. Students in the Teacher Licensure option may choose to add a second teaching area specialization such as middle school, health education, or coaching.

The department offers a minor in educational services in family and consumer sciences. The minor is earned by successfully completing 15 credits in FCEdS 206, 206L, 306, 415, and 418. The department cooperates in the journalism and mass communications concentration in family and consumer studies. See department for details.

English Proficiency Requirement: C or better in Engl 104 and 105.

Graduate Study

The department offers work for the degrees master of science, master of education, and doctor of philosophy, each with the major, family and consumer sciences education. The M.S. degree requires a thesis; the M.Ed. degree requires a creative component; the Ph.D. requires a dissertation. Minors are available.

Programs for advanced degrees with a major in family and consumer sciences education are tailored to fit the educational background, experience, and professional goals of the student. Areas of study provided by the department include program planning, curriculum, evaluation, research methods, supervision and administration, international education and development, and teacher education. Opportunities are available for strengthening one's background in subject matter in other departments in the College of Family and Consumer Sciences.

Students who complete a graduate program are professional family and consumer sciences educators and teacher educators who foster program planning, implementation, and evaluation at state, national, and international levels. They are producers and disseminators of research and scholarship in family and consumer sciences education and are leaders in programs and services for clientele in diverse settings.

The department cooperates in the housing and gerontology interdepartmental minors. The department also cooperates with the departments of Agricultural Education and Studies, Industrial Technology, and Educational Leadership and Policy Studies in offering the degree master of education with an area of specialization in vocational education (see *Index*).

Courses open for nonmajor graduate credit: 413, 415.

Courses Primarily for Undergraduate Students

FCEdS 110. College of Family and Consumer Sciences Orientation. (1-0) Cr. R. F.S. Half-term. Orientation to the university, the college, and the college curricula. Adjustment to the university; discussion of student responsibilities, study skills, and management of time and energy. Development of a long-term curriculum plan. Offered on a satisfactory-fail grading basis only.

FCEdS 160. Foundations of Family and Consumer Sciences. (1-0) Cr. 1. F.S. Historical development and philosophical base of family and consumer sciences. Integrative focus for disciplines and areas of specialization.

FCEdS 206. Professional Roles in Family and Consumer Sciences. (2-0) Cr. 2. F. *Prereq:* 160. Introduction to various roles in professional settings, e.g., community agencies, secondary schools, business and industry, Cooperative Extension.

FCEdS 206L. Laboratory for Educational Roles in Family and Consumer Sciences. (0-3) Cr. 1. F. *Prereq:* Enrollment in 206. Observation, participation, and teaching experiences in educational settings. Materials fee.

FCEdS 306. Educational Principles for Family and Consumer Sciences. (2-2) Cr. 3. F. *Prereq:* 15 credits in family and consumer sciences subject matter. Principles of teaching and learning applied to family and consumer sciences content. Instructional methods appropriate for formal and nonformal educational

settings. Specific strategies for diverse audiences. May be used for family life certification. Materials fee.

FCEdS 310. Career Opportunities. (1-0) Cr. R. F.S. Half-term. *Prereq:* Credit or enrollment in 160. Survey of current professional opportunities and preparation for the job search process. Transition from student to professional role. Materials fee. Offered on a satisfactory-fail grading basis only.

FCEdS 314. Computer Applications for Training and Development. (Dual-listed with 514.) (2-0) Cr. 2. S. Application of computer resources for development and presentation of instructional sequences in family and consumer sciences.

FCEdS 318. Occupational Programs. (2-0) Cr. 2. S. *Prereq:* 206 and 400 hours work experience in a family and consumer sciences related job. Planning and implementing programs in occupational family and consumer sciences including FHA/HERO. Impact of selected legislation on family and consumer sciences programs. Techniques for cooperative education, school-to-work, and work-based education programs. Can be used toward Multi-Occupation Cooperative endorsement.

FCEdS 379. Educational Aspects of Family Social Issues. (3-0) Cr. 3. S. Examination of family and social issues from diverse perspectives. Application of critical thinking and reflection to family and social issues within formal and nonformal educational settings.

FCEdS 403. Student Assessment for Vocational Family and Consumer Sciences. (2-0) Cr. 2. S. *Prereq:* Enrollment in 413 and 50 hours of early experience in public schools. Philosophy of student assessment. Development and critique of tests and authentic assessment tools to measure cognitive, affective, psychomotor, and perceptual learning. Procedures for grading, interpreting, and reporting assessment data.

FCEdS 413. Curriculum Planning for Family Life and Vocational Family and Consumer Sciences. (2-2) Cr. 3. S. *Prereq:* 306. Philosophy of vocational education. Curriculum development in family and consumer sciences programs for school settings. May be used for family life certification. Materials fee. Nonmajor graduate credit.

FCEdS 415. Program Planning and Evaluation in Family and Consumer Sciences. (6-0) Cr. 3. S. First half-term. *Prereq:* 306. Program development principles including needs analysis, planning, instruction, promotion, evaluation, grant writing and reporting. Approaches appropriate for diverse groups. Environmental and cultural conditions affecting programs. Nonmajor graduate credit.

FCEdS 417. Supervised Teaching in Family and Consumer Sciences. F.S. *Prereq:* 413, 24 credits in family and consumer sciences subject matter, cumulative grade point of 2.50, full admission to teacher education. Supervised teaching experience in secondary schools. Examination of ways to implement actions that reflect a professional philosophy of family and consumer sciences for teaching middle and high school level students. May be taken more than once for credit. Reservation required.

- A. Vocational family and consumer sciences. Cr. 8.
- B. Family and consumer sciences. Cr. 3 to 8.

FCEdS 418. Supervised Experiences in a Professional Setting. Cr. 3 to 8. F.S.SS. Supervised professional experience in an approved setting such as Cooperative Extension, business; community, human service, or government agency. May be taken more than once for credit. Reservation required.

A. Educational Services. *Prereq:* 415, 24 credits in family and consumer sciences.

B. Studies in Family and Consumer Sciences. *Prereq:* 379 or 421, 24 credits in family and consumer sciences.

FCEdS 421. International Perspectives of Family and Consumer Sciences. (Dual-listed with 521.) (3-0) Cr. 3. S. *Prereq:* 6 credits in family and consumer sciences. Examination of family and consumer sciences from an international perspective; focus on the roles and responsibilities of women in development. Application and adaptation of content

David B. Smith, Chair of Department

Professors: Ralston, Stover

Associate Professors: Campbell, Carter, Cowan, Dark, Koppenhaver, Power

Assistant Professors: Howell, Piwowar

Undergraduate Study

For undergraduate curriculum in business, major in finance, see *College of Business, Curricula*.

In addition to the basic business requirements, finance majors must also complete: (1) Fin 352, 354; (2) select three from Fin 351, 357, 358, 451, 452, 453, 454, 455, 457, 459, 499; and (3) select two from Econ 301, 344, 353, 355, Acct 383, 385, 386, 387, 388, any 400-level accounting course.

The courses in finance constitute a broad program of study designed to provide a descriptive, behavioral, and analytical background of financial management to enable students to qualify for opportunities in financial services, insurance, brokerage, government, real estate, and financial management of business enterprises. Finance is also an excellent area for those who wish to become more knowledgeable as consumers, particularly in the fields of investments, insurance, and real estate.

Areas of study in the field of finance include financial management, investments, insurance, real estate, and financial services. Upper-level courses include a review of contemporary literature in the field, case studies, and financial problem analysis integrating finance courses previously taken.

The instructional objective of the Finance program is to provide a well-rounded professional education in finance. Such an education should provide the student with: (1) a mastery of basic financial concepts and methods of analysis; (2) an understanding of financial operations in a global setting and of the role of financial institutions in the economics system; (3) an ability to effectively communicate and work with others as the finance member of a team; (4) an ability to demonstrate leadership capabilities in financial analysis and portfolio management.

Graduate Study

The department participates in two graduate degree programs: the M.S. in business administrative sciences and the M.B.A. full-time and part-time programs. The M.S. degree in business administrative sciences is a 30-credit curriculum culminating in a thesis. The M.B.A. program is a 48-credit, nonthesis, noncreative component curriculum. Twenty four of the 48 credit hours are core courses and the remaining 24 are graduate electives. Within the M.B.A. program, students may develop an area of specialization in finance. This specialization requires that 12 of the 24 credit hours of the graduate electives be from an approved list of graduate finance courses.

to working with families in other countries and cultures. Student participation in cultural activities.

FCEdS 460. Integrative Approaches in Family and Consumer Sciences. (1-0) Cr. 1. F.S. Half-term. *Prereq: 160.* Seminar on ways professionals work across disciplines to address contemporary social issues that affect individuals and families. Methods to initiate public policy at the local, national, and international levels. Intended primarily for seniors.

FCEdS 490. Independent Study. Cr. arr. *Prereq: Departmental approval.*

- A. Adult Education
- C. Curriculum
- D. Evaluation
- E. Cooperative Extension
- G. General
- H. Honors
- I. International
- K. Occupational Education
- N. Human Relations
- P. Special Needs/Mainstreaming
- R. Vocational Education
- S. Distance Education

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

FCEdS 500. Short Course: Current Family and Consumer Sciences Offerings. Cr. 1 to 3. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education.* May be taken more than once for credit.

- A. Adult Education
- B. Supervision and Administration
- C. Curriculum
- D. Evaluation
- E. Teacher Education
- F. Occupational/Vocational Education
- G. General
- H. Research Methodology
- I. International Education
- J. Middle Level Education

FCEdS 507. Program Development in Family and Consumer Sciences. (3-0) Cr. 3. F. *Prereq: Professional experience in family and consumer sciences or related area.* Application of principles of program development to formal and nonformal educational settings, e.g., secondary school family and consumer sciences programs, training positions in business, Cooperative Extension, human services agencies.

FCEdS 508. Models for Teaching Family and Consumer Sciences. (2-0) Cr. 2. Alt. F., offered 2000. *Prereq: 6 credits in family and consumer sciences.* Selecting teaching strategies and instructional materials based on theories of learning and human development that reflect a professional philosophy of family and consumer sciences. Application to formal and nonformal educational settings with diverse audiences.

FCEdS 511. Research Methods. (3-0) Cr. 3. F.S. *Prereq: Graduate classification.* An overview of diverse research approaches focusing on methods for collecting and analyzing quantitative and qualitative data. Critique of research reports and development of research proposals.

FCEdS 513. Computer Applications for Research in Family and Consumer Sciences. (2-0) Cr. 2. F. *Prereq: Enrollment in 511.* Using computer applications in graduate education and research processes. Emphasis on data coding, conversion and analyses.

FCEdS 514. Computer Applications for Training and Development. (Dual-listed with 314.) (2-0) Cr. 2. S. *Prereq: Graduate classification.* Application of computer resources for development and presentation of instructional sequences in family and consumer sciences. Critique of professional information sources available through network systems.

FCEdS 515. Assessment in Family and Consumer Sciences. (3-0) Cr. 3. S. *Prereq: Introductory statistical and program development skills.* Role of assessment in family and consumer sciences education programs. Planning and constructing test items and other assessments of school and nonschool learning.

FCEdS 520. Supervision in Family and Consumer Sciences Programs. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: Professional experience or 6 credits in family and consumer sciences.* Examination of change, communication and leadership theories as related to supervision. Application of conferencing techniques, observation skills, and performance evaluation to professional leadership positions in educational settings.

FCEdS 521. International Perspectives of Family and Consumer Sciences. (Dual-listed with 421.) (3-0) Cr. 3. S. *Prereq: 6 credits in family and consumer sciences.* Examination of family and consumer sciences from an international perspective; focus on the roles and responsibilities of women in development. Application and adaptation of content to working with families in other countries and cultures. Student participation in cultural activities and critique of international research articles.

FCEdS 590. Special Topics. Cr. arr. *Prereq: 6 credits in family and consumer sciences or education.*

- A. Adult Education
- B. Administration
- C. Curriculum
- D. Evaluation
- E. Teacher Education
- F. Occupational/Vocational Education
- G. General
- H. Research Methodology
- I. International Education
- J. Educational Gerontology
- K. Human Relations
- L. Special Needs
- M. Family Life Education
- N. Human Sexuality
- O. Technology
- P. Supervision
- Q. Family/Individual Health
- R. Consumer Education
- S. Distance Education

FCEdS 593. Workshop. Cr. 1 to 3. F.S.SS. *Prereq: 6 credits in family and consumer sciences or education.* Concentrated group study of new developments in family and consumer sciences education. Sections offered will vary from year to year. May be taken more than once for credit.

FCEdS 599. Creative Component.

Courses for Graduate Students

FCEdS 607. Curriculum Theory and Philosophy in Family and Consumer Sciences. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: 507 or curriculum development experience.* Integration of philosophies of education and family and consumer sciences into an operative philosophy of curriculum development. Study of various curriculum theories and approaches to curriculum development.

FCEdS 610. Seminar. Cr. 1. F.S. *Prereq: Graduate classification.* Exploration of trends and issues in the profession. May be taken more than once for credit. Offered on a satisfactory-fail grading basis only.

FCEdS 611. Program Evaluation in Family and Consumer Sciences. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: 511, 515.* Application of program evaluation approaches and models to family and consumer sciences programs. Standards for program evaluation.

FCEdS 618. Coordination of Educational Programs in Family and Consumer Sciences. Cr. 2. Alt. F., offered 1999. *Prereq: 520.* Approaches to coordination of family and consumer sciences programs in adult education, extension, state department of education, and teacher education. Study of undergraduate programs in family and consumer sciences education, observation and participation in undergraduate courses, and practicum experience.

FCEdS 620. Theories of Administration in Family and Consumer Sciences. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: Professional Experience.* Review of administrative theory; application to family and consumer sciences programs with emphasis on higher education. Administrative leadership roles, and their interrelationships. Consideration of current issues.

FCEdS 699. Research.

Fully-admitted M.B.A. degree candidates with previous business study as an undergraduate may qualify for advanced entry into the M.B.A. program. Advanced entry is designed to serve those students with a bachelor's degree in business as they may complete the M.B.A. degree program requirements in as few as 30 semester credit hours. Information about the advanced M.B.A. entry application process can be obtained in the College of Business Graduate Programs Office, 218 Carver Hall.

Courses open for nonmajor graduate credit: 452, 453, 454, 455, 457, 459.

Courses Primarily for Undergraduate Students

Fin 350. Business Finance. (3-0) Cr. 3. F.S.SS. *Prereq:* Acct 284; Econ 101, Stat 101 or 227. Introduction to financial management with emphasis on corporate financial decision making, financial statement analysis, time value of money, asset management, valuation of the firm, and use of funds.

Fin 351. Real Estate Principles. (3-0) Cr. 3. F.S. *Prereq:* Econ 101. Legal, economic, social and financial aspects of real estate, including property rights, contracts, mortgage instruments, tax factors, brokerage, valuation, risk and return analysis, financing techniques, and investments.

Fin 352. Advanced Business Finance. (3-0) Cr. 3. F.S.SS. *Prereq:* 350. Theory used in a firm's investment and financing decisions. Analysis of environment in which financial decisions are made; applications of analytical techniques to financial management problems.

Fin 354. Principles of Investments. (3-0) Cr. 3. F.S.SS. *Prereq:* 350. Introduction to various investment media and markets from the viewpoint of the individual investor. Emphasis on financial planning, behavior of security markets, corporate stocks and bonds, individual asset and portfolio selection techniques.

Fin 357. Insurance Principles. (3-0) Cr. 3. F.S. *Prereq:* Econ 101. Risk concepts and the use of insurance by individuals and families. Emphasis on the insurance mechanism and methods of dealing with income, property, and liability risks.

Fin 358. Management of Financial Institutions. (3-0) Cr. 3. F.S. *Prereq:* 350. Analysis of operations of depository financial institutions from management viewpoint. Emphasis on evaluating performance, policy formation, asset and liability management, the role of capital, and the operating environment.

Fin 451. Real Estate Finance and Investment. (3-0) Cr. 3. *Prereq:* 350, 351. Introduction to the techniques of assessing the value of real estate and real estate financing instruments.

Fin 452. International Financial Management. (3-0) Cr. 3. F.S. *Prereq:* 350. Advanced study of contemporary topics and issues in international finance. Nonmajor graduate credit.

Fin 453. Business Financing Decisions. (3-0) Cr. 3. *Prereq:* 350. In depth study of the firm's external financing decision. Emphasis on the development of cash flow statements, projected financing needs and the selection of the appropriate financing instrument. Focus on case studies and application of developed techniques on actual field project. Nonmajor graduate credit.

Fin 454. Financial Futures and Options. (3-0) Cr. 3. *Prereq:* 354. Advanced study of the pricing and use of derivative market instruments, current topics and issues. Nonmajor graduate credit.

Fin 455. Corporate Risk and Insurance Financing. (3-0) Cr. 3. *Prereq:* 357. Analysis of an organization's approaches to risk transfer, loss financing, and risk management. Emphasis on commercial and group insurance coverages, self-insurance, and alternative financing arrangements including captive insurers. Nonmajor graduate credit.

Fin 457. Management of Insurance Companies. (3-0) Cr. 3. F. *Prereq:* 357. Functional analysis of insurance company operations from a management perspective. Emphasis on organization, policy formation, regulation, financial statements, solvency requirements, and new product planning. Nonmajor graduate credit.

Fin 459. Financing New Ventures. (3-0) Cr. 3. *Prereq:* 350. Financial, control and investment opportunities faced by new and rapidly growing companies in entrepreneurial settings. Emphasis on the consideration and selection of financing vehicles appropriate to securing the new and growing firms' financial requirements and the decision making framework underlying these issues. Covers acquisition of start-up capital to growth financing to "harvest" of the firm through an initial public offering. Nonmajor graduate credit.

Fin 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq:* 350, permission of instructor.

Fin 499. Finance Internship. (3-0) Cr. 1 to 3. F.S.SS. *Prereq:* GPA 2.5; permission of internship coordinator; 499A: 358 or 453; 499B: 357; 499C: 351. Supervised experience in a private sector banking, insurance or real estate organization or in a governmental agency that regulates such organizations. No more than 3 credits may be counted toward the finance area requirement. Offered on a satisfactory-fail grading basis only.

- A. Banking
- B. Insurance
- C. Real Estate

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Fin 505. Financial Valuation and Corporate Financial Decisions. (2-0) Cr. 2. *Prereq:* Graduate classification. Shareholder wealth maximization as the goal of the firm, financial math, valuation of securities, the financial market place as the test of value, estimation of cost of capital, capital investment decisions, capital structure policy, working capital management.

Fin 550. Financial Management. (3-0) Cr. 3. *Prereq:* Acct 284, Econ 101. Financial management problems; relationship of finance with other functions within the firm, including practical and theoretical methods of financial analysis as part of a system of management decisions.

Fin 552. Advanced Financial Management. (3-0) Cr. 3. *Prereq:* 550 or 505. Modern theory of corporate finance and its application to financial management problems. Advanced treatment of firm's investment, financing, and dividend decisions and survey of related research. Examples of potential topics are the investment banking process, convertible securities and warrants, financial derivatives, asset leasing, mergers and divestitures, leveraged buyouts, international financial management, executive compensation, and pension fund strategy.

Fin 554. Investments. (3-0) Cr. 3. *Prereq:* 550 or 505. A comprehensive survey of the classical and contemporary theories of optimum portfolio construction; determinants of risk-return trade-off in selection of securities; emphasis on the theory and evidence of efficient capital markets and implications for security selection and portfolio management.

Fin 555. Employee Benefits Seminar. (3-0) Cr. 3. *Prereq:* Graduate classification. Theory of employee benefits including benefit types, purpose, utilization, costs/methods of benefit financing and regulation.

Fin 556. Corporate Financial Decisions. (3-0) Cr. 3. *Prereq:* 550 or 505. This course focuses on case studies to develop an integrated set of financial decisions. Topic areas include fixed asset, working capital, capital structure, dividend and merger/acquisition decisions. The objective of the course is to examine different firm settings and establish a framework within which to apply financial tools.

Fin 590. Special Topics. Cr. 1 to 3 each time taken. F.S.SS. *Prereq:* Permission of instructor. For students wishing to do individual research in a particular area of finance.

Food Science and Human Nutrition

www.ag.iastate.edu/departments/foodsci/FoodSci

Diane F. Birt, Chair of Department

Distinguished Professors: Olson

University Professors: Glatz, Hammond, Parrish, Sebranek

Professors: Birt, Hendrich, Hurburgh, Jane, Johnson, Kaplan, LaGrange, Murphy, Nikolau, Nikolov, Olson, Pometto, Prusa, Robson, Schafer, Serfass, Stromer, Swan, Topel, P. White, Wilson

Distinguished Professors (Emeritus): Jacobson, Roderuck

Professors (Emeritus): Dupont, Garcia, Kraft, McMillan, Runyan, Rust, Walker

Associate Professors: Ford, Lewis, J. Love, M. Love, Madden, Myers, Oakland, Reitmeier, Sharp, Wurtele

Associate Professors (Emeritus): Bohnenkamp, McCamber

Assistant Professors: Alekel, Boylston, Briggs, Marquis, Mendonca, Reddy, Schalinske, W. White

Instructors (Adjunct): Anderson, Bassler, Litchfield

The Department of Food Science and Human Nutrition is jointly administered by the College of Agriculture and the College of Family and Consumer Sciences. All curricula offered by the department are available to students in either college. These curricula include dietetics, food science, and nutritional science. Visit our web site at: www.ag.iastate.edu/departments/foodsci/Foodsci.

Undergraduate Study

The general dietetics curriculum is approved by the American Dietetic Association (ADA) and meets the academic requirements for admission to accredited dietetics internships. The dietetic program includes study in basic sciences, nutrition, and food science applications to medical dietetics and community nutrition. Foodservice management is also an important aspect of the program. Graduates work in hospitals, clinics, long-term care facilities, food and pharmaceutical industries, and government nutrition programs; some are private and home health care nutrition consultants.

Food science is a discipline in which the principles of biological and physical sciences are used to study the nature of foods, the causes of their deterioration, and the principles underlying the processing and preparation of food. It is the application of science and technology to the provision of a safe, wholesome, and nutritious food supply. Biotechnology and toxicology interrelate with food science in the area of food safety. In the food industry, food scientists work in research and development of products or processes, production supervision, quality control, marketing and sales, test

kitchens and recipe development, product promotion and communication. Food scientists also serve in government regulatory agencies and academic institutions.

Three options are available in food science: food science and technology, food science and industry, and consumer food science. The food science and technology option is approved by the Institute of Food Technologists, the national professional organization of food science. Students interested in quality control/assurance; production supervision; management and sales; or research careers in the food industry, government, or academia should elect either the food science and technology or the food science and industry option. Students who wish to go to graduate or professional school or who are biotechnology scholars in the College of Agriculture should elect food science and technology. Students who wish to emphasize business, journalism, or special aspects of food science should elect food science and industry. Students interested in test kitchen positions, food product formulation and recipe development, food promotion, and consumer services in government and industry should elect the consumer food science option. Pre-veterinary and prehealth professional preparation is available through the food science and technology option.

Students who wish to combine education in engineering with food science may elect the food engineering option in the agricultural engineering curriculum or may arrange special five-year programs.

Nutritional science offers students a strong basic science and general education that enables them to gain the knowledge and skills necessary to work in research laboratories of colleges and universities, government agencies, industries, and foundations. The curriculum can serve as a preprofessional program for medicine, dentistry, veterinary medicine, or for graduate study in nutrition or other biological sciences.

Students graduating with degrees in dietetics, food science, or nutritional science should: 1) be able to prepare and deliver technical information to food science and nutrition professionals as well as to the general public; 2) be able to find, evaluate and interpret research literature in food science and/or nutrition; 3) demonstrate the ability to define a problem, distinguish verifiable facts from value claims, identify assumptions and detect bias, distinguish relevant information, identify sources of conflicts, and prioritize needs; 4) be well prepared to gain entry into graduate or supervised practice programs; 5) successfully perform in entry level positions in dietetics, nutrition, or the food industry.

See also the B.S./M.S. program under *Graduate Study*.

The department offers minors in food science and in nutrition. See department office or web site for requirements.

English proficiency is certified by a grade of C or better in 6 credits of coursework in composition (Engl 104 and 105 or other communication-intensive courses) and a grade of C or bet-

ter in 3 credits of coursework in oral communication.

Postbaccalaureate Program

A dietetic internship program has received developmental accreditation from the American Dietetic Association. For more information, refer to *Special Interest Programs* listed under the *College of Family and Consumer Sciences* or contact the department. There is a nonrefundable application fee of \$30 and a program fee of \$500 payable upon acceptance into the program.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in food science and technology and in nutrition, and minor work for students taking major work in other departments. Graduate work in meat science is offered as a co-major in animal science and food science and technology.

Prerequisite to major work is a baccalaureate degree in food science, nutrition, or other physical or biological sciences or engineering that is substantially equivalent to those at Iowa State University.

Students taking major work for the degree doctor of philosophy either in food science and technology or in nutrition may choose minors from other fields including anthropology, chemistry, biochemistry, economics, education, journalism, microbiology, psychology, physiology, sociology, statistics, toxicology, or other related fields.

Faculty in the department participate in the major in microbiology; the interdepartmental majors in genetics, MCDB (molecular, cellular, and developmental biology), toxicology, and water resources; and the interdepartmental minor in gerontology.

The department offers a B.S./M.S. program that allows students to obtain both the B.S. and M.S. degrees in 5 years. The program is available to students in the food science and technology option or the nutritional science curriculum. Students interested in this program should contact the department for details. Application for admission to the Graduate College should be made near the end of the junior year. Students begin research for the M.S. thesis during the summer after their junior year and are eligible for research assistantships.

Students graduating with advanced degrees in food science and technology or nutrition should: 1) be able to conduct and interpret research in food science and/or nutrition; 2) be able to present clear, organized, informational seminars; 3) be able to communicate effectively with students in the classroom or teaching laboratory; 4) write an abstract or paper to be submitted for publication; 5) perform successfully in professional-level positions in food science or nutrition; 6) have a comprehensive background in food science and/or human nutrition.

Courses open for nonmajor graduate credit: 311, 342, 351, 360, 372, 403, 405, 410, 411, 412, 419, 420, 421, 463, 471.

Courses Primarily for Undergraduate Students

FS HN 101. Food and the Consumer. (3-0) Cr. 3. F.S. *Prereq: High school biology and chemistry or 3 credits each of biology and chemistry.* The food system from point of harvest to the consumption of the food by the consumer. Properties of food constituents. Protection of food against deterioration and microbial contamination. Introduction of foods into the marketplace. Processes for making various foods. Government regulations. Use of food additives. Current and controversial topics. Electronic communication from web emphasized for class reports, notes and assignments.

FS HN 105. Regulation of Body Weight. (2-0) Cr. 2. Alt. S., offered 2000. *Prereq: 167, Biol 109, or Chem 163.* Introduction to body composition, fat and muscle biology, macronutrient metabolism, and energy expenditure. The role of genes, diet, and physical activity in weight control will be examined in recently published human studies. Students will develop an individual weight maintenance program.

FS HN 110. Orientation. (1-0) Cr. 0.5. F. Orientation to the department, to Iowa State University, and to careers in food science, nutrition, and dietetics. Curriculum and career planning. Offered on a satisfactory-fail grading basis only.

FS HN 167. Introduction to Human Nutrition. (3-0) Cr. 3. F.S.SS. *Prereq: High school biology or 3 credits of biology.* Understanding and implementing present day knowledge of nutrition. The use of food for health and satisfaction of the individual and the family.

FS HN 202. Food Quality Evaluation. (2-3) Cr. 3. S. Effect of processing on food quality. Federal regulations pertaining to the safety and quality of raw and processed foods. Emphasis on Food and Drug Administration (FDA) and U.S. Department of Agriculture (USDA) standards and quality grading of foods. Food quality evaluated using official (government and industry) instrumental, chemical, and sensory procedures. Materials fee.

FS HN 203. Family and Consumer Sciences and Agricultural Systems in Contemporary Societies. (1-0) Cr. 1. F.S. Major family and consumer sciences and agricultural problems and their relatedness. Impact of economic, political, social, technological, and belief systems. Emphasis on population, public policy, food production, food and water availability and safety, nutrition problems.

FS HN 211. Fundamentals of Food Preparation. (2-3) Cr. 3. F.S. *Prereq: 167; Chem 163, 163L.* Principles involved in preparation of food products of standard quality. Influence of composition and techniques on properties of food products. Standard methods of food preparation with emphasis on quality, nutrient retention, and safety. Either 211 or 214, but not both, may be used for credit toward graduation. Materials fee.

FS HN 214. Scientific Study of Food. (3-6) Cr. 5. F.S. *Prereq: Chem 231 or 331.* Composition and structure of foods. Principles and practice of preparation of standard quality food products. Behavior and interactions of food constituents. Either 211 or 214, but not both, may be used for credit toward graduation. Materials fee.

FS HN 228. Exercise and Nutrition for Lifetime Wellness. (Same as Ex Sp 228.) (3-0) Cr. 3. F.S. Principles of exercise and nutrition which provide a basis of information for life-long wellness. Open to non-majors only.

FS HN 261. Fundamentals of Human Nutrition. (2-0) Cr. 2. S. *Prereq: A course in statistics; credit or enrollment in BBMB 301 or Biol 302.* Nutrient composition of foods, nutrient requirements and dietary recommendations, formulation of diet plans, fundamentals of nutrient metabolism.

FS HN 273. Processing of Dairy Products. (2-3) Cr. 3. S. *Prereq: Biol 109 or 201 or 202; Chem 163.* Composition of dairy products. Procedures used in manufacturing, distributing, and controlling the quality of various dairy products; some pilot plant experiences. Materials fee.

FS HN 298. Cooperative Education. Cr. R. F.S.S.S. Prereq: *Permission of the department chair; sophomore classification.* Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

FS HN 311. Food Chemistry. (2-3) Cr. 3. F. Prereq: *Chem 231 and 231L or 331 and 331L; credit or enrollment in BBMB 301.* The structure, properties, and reactions of food constituents and commodities. Materials fee. Nonmajor graduate credit.

FS HN 340. Introduction to Dietetics. (1-0) Cr. 1. F. Roles of dietitians; professional ethics; health care delivery systems. Offered on a satisfactory-fail grading basis only.

FS HN 342. World Food Issues: Past and Present. (Same as Agron 342, T SC 342, U St 342.) (3-0) Cr. 3. F. World food problems in context of historical development of agriculture in major cradles of civilization. Emphasis on population trends and socioeconomic policies to understand disparities between potential agriculture production and present energy and nutritional deficiencies in key areas of the developing world. Team projects. Materials fee. Nonmajor graduate credit.

FS HN 351. Unit Operations in Food Processing. (3-0) Cr. 3. S. Prereq: *A course in calculus and Phys 106.* Introduction to material and energy balances. Fluid flow, physical and thermal properties of food materials. Fundamentals of heat and mass transfer. Application of momentum and heat transfer to unit operations in food processing. Calculations and computer applications in food processing. Nonmajor graduate credit.

FS HN 360. Human Nutrition and Metabolism. (3-0) Cr. 3. F. Prereq: *261, 3 credits in biochemistry; 3 credits in physiology recommended.* Physiological and chemical bases for nutrient needs. Factors to consider in satisfying those needs for individuals and populations. Nonmajor graduate credit.

FS HN 361. Human Nutrition Laboratory. (1-3) Cr. 2. F.S. Prereq: *Credit or enrollment in 360.* Laboratory experiences in dietary analysis, metabolic balance, and nutritional status assessment. Materials fee.

FS HN 362. Nutrition in Growth and Development. (3-0) Cr. 3. S. Prereq: *360; credit or enrollment in a course in physiology.* Nutrition throughout the human life cycle. Interrelationships of nutrition and biological growth and development. Role of nutrients in cell replication, differentiation, senescence and apoptosis. The interrelationships between genes, gene expression and nutrients with physiological outcomes during human development and aging.

FS HN 372. Processing of Fruits and Vegetables. (2-3) Cr. 3. Alt. F., offered 2000. Prereq: *202 or Hort 422 or 461 or 471.* Harvesting, handling, processing, and storage of fruits and vegetables; some pilot plant experiences. Current practices and problems. Color, flavor, texture, composition, nutritional value, and safety of raw and processed fruits and vegetables. Materials fee. Nonmajor graduate credit.

FS HN 398. Cooperative Education. Cr. R. F.S.S.S. Prereq: *Permission of the department chair; junior classification.* Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

FS HN 403. Food Laws, Regulations, and the Regulatory Process. (2-0) Cr. 2. F.S. Prereq: *Previous coursework in food science at 200 level or above.* History of the development of the current federal and state food regulations. Guidelines that govern the practice of regulating the wholesomeness of red meats, poultry, and eggs. Presentations by state and federal food regulators. Nonmajor graduate credit.

FS HN 405. Food Quality Assurance. (2-2) Cr. 3. S. Prereq: *202 or 214, Stat 101 or 104.* Basis of food quality control/assurance programs and establishment of decision-making processes. Statistical process and quality control procedures (charts and sampling) and their applications to various food systems. Development of hazard analysis, specifications, grades, and standards. Materials fee. Nonmajor graduate credit.

FS HN 406. Sensory Evaluation of Food. (Dual-listed with 506.) (2-3) Cr. 3. F. Prereq: *214 or 311 or An S 360; 3 credits in statistics.* Sensory test methods and procedures used to evaluate the flavor, color and texture of foods. Relationships between sensory and instrumental measurements of color and texture. Acceptance and preference testing. Materials fee.

FS HN 407. Microbial Safety of Food. (Same as Micro 407.) See *Microbiology*.

FS HN 410. Food Analysis. (2-3) Cr. 3. S. Prereq: *214 or 311 or BBMB 311 or Chem 211.* An introduction to the theory and application of physical and chemical methods for determining the constituents of food. Modern separation and instrumental analysis. Use of food composition data bases. Materials fee. Nonmajor graduate credit.

FS HN 411. Experimental Study of Food. (2-3) Cr. 3. F. Prereq: *214 or 311; a course in biochemistry.* Experimental approach to the study of factors influencing behavior of foods. Materials fee. Nonmajor graduate credit.

FS HN 412. Food Product Development. (Dual-listed with 512.) (2-6) Cr. 4. S. Prereq: *311 or 411, 471.* Principles of developing consumer packaged food products. Application of skills gained in food chemistry, formulation, microbiology, and processing. Some pilot plant experiences. Electronic communication from web emphasized for class reports, notes and assignments. Materials fee. Nonmajor graduate credit.

FS HN 416. Family Foods and Wines of Selected Cultures. (2-3) Cr. 3. S. Prereq: *211 or 214, 311 or 411; permission of instructor.* Family food patterns emphasizing European cultures. An exploration of the classical wines of Europe and their American counterparts with emphasis on sensory techniques. Materials fee.

FS HN 419. Foodborne Hazards. (Same as Micro 419 and Tox 419.) (3-0) Cr. 3. Alt. S., offered 2000. Prereq: *Micro 201 or 302, a course in biochemistry.* Pathogenesis of human microbiological foodborne infections and intoxications, principles of toxicology, major classes of toxicants in the food supply, governmental regulation of foodborne hazards. Nonmajor graduate credit.

FS HN 420. Food Microbiology. (Same as Micro 420, Tox 420.) (3-0) Cr. 3. F. Prereq: *Micro 302.* Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganism in food and water. Foodborne infections and intoxications. Nonmajor graduate credit.

FS HN 421. Food Microbiology Laboratory. (Same as Micro 421.) (1-6) Cr. 3. F. Prereq: *Micro 201 or 302; 201L. Credit or enrollment in 420 (Micro 420).* Standard microbiological techniques employed in the food industry, including microscopic examination of foods, plate counts, other enumeration methods, indicator organisms of food quality and safety, foodborne pathogens, and molds. Materials fee. Nonmajor graduate credit.

FS HN 425. Food Biotechnology. (Dual-listed with 525; same as Micro 425.) (2-3) Cr. 3. Alt. S., offered 2001. Prereq: *Micro 201L, 302; a course in biochemistry.* Introduction to genetic engineering and fermentation technology and their applications in the food industry; immunological and DNA detection methods; bioethics. Laboratories include all steps in production of a recombinant food enzyme from genetic engineering through fermentation, recovery and characterization. Field trip fee. Materials fee.

FS HN 441. Hospital Food and Nutrition Services. (1-9) Cr. 6. S.S. For students enrolled in the dietetic internship program. Supervised participation in and analysis of food production, delivery, and other functions related to hospital food and nutrition services. Materials fee. Offered on a satisfactory-fail grading basis only.

FS HN 442. Medical Dietetics I. (3-15) Cr. 8. F.S.S. For students enrolled in the dietetic internship program. Biological basis of medical, drug, and diet therapy for selected pathologies. Consideration of factors in planning and conducting nutritional care of patients. Integration of principles with clinical experi-

ence. Materials fee. Offered on a satisfactory-fail grading basis only.

FS HN 445. Experience in Community Dietetics. (0-6) Cr. 2. S.S. For students enrolled in the dietetic internship program. Supervised experience in planning and providing nutritional care for individuals and groups in a variety of community settings. Offered on a satisfactory-fail grading basis only.

FS HN 446. Experience in Dietetic. (2-0) Cr. 2. F.S. Prereq: *For students enrolled in dietetics internship.* Supervised experience in planning and providing nutrition education for individuals and groups in a variety of dietetic settings. Offered on a satisfactory-fail grading basis only.

FS HN 461. Disease and Medical Nutrition Therapy I. (Dual-listed with 561.) (3-2) Cr. 4. F. Prereq: *362, 3 credits in physiology.* Pathophysiology of selected medical problems with specific attention to nutritional needs and treatment as part of medical nutrition therapy. Clinical nutrition applications in acute and chronic disease. Assessment of nutritional problems, nutrition care, planning and documentation.

FS HN 463. Community Nutrition. (2-3) Cr. 3. F. Prereq: *362.* Survey of current public health nutrition problems among nutritionally vulnerable individuals and groups. Discussion of the multidimensional nature of those problems and of community programs designed to help solve them. The role of community nutritionists. Nonmajor graduate credit.

FS HN 464. Disease and Medical Nutrition Therapy II. (Dual-listed with 564.) (2-3) Cr. 3. S. Prereq: *461.* Pathophysiology of selected disease states and medical problems. Specific attention will be directed to nutrition needs and treatment of each disease state. Clinical nutrition applications in acute and chronic disease. Assessment of nutritional problems, nutrition care, planning and documentation.

FS HN 466. Nutrition Counseling and Education Methods. (2-2) Cr. 3. F.S. Prereq: *Credit or enrollment in 362; Sp Cm 212.* Nutrition education for groups and individuals in clinical and community settings. Includes discussion and experience in applying learning theory, assessing educational needs, stating goals and objectives, selecting learning activities, implementing and evaluating instruction, and documenting care provided. Materials fee.

FS HN 471. Food Processing. (3-0) Cr. 3. F. Prereq: *101 or 202 or 214; Micro 201 or 302; Chem 163; Phys 106.* Food preservation, including packaging, fermentation, irradiation, canning, freezing, dehydration, additives. Sanitation and plant design. Applications to food products. Nonmajor graduate credit.

FS HN 472. Food Processing Laboratory. (Dual-listed with 572.) (1-3) Cr. 2. F. Prereq: *351; credit or enrollment in 471.* Pilot plant experiences in thermal processing, food fermentations, oil seed processing, food extrusion. Materials fee.

FS HN 480. Professional Seminar in Food Science and Human Nutrition. (1-0) Cr. 1. F.S. Prereq: *Senior classification in the department.* Exploration of current research and issues relevant to professionals in food science and human nutrition.

FS HN 490. Independent Study. Cr. arr. F.S.S.S. Prereq: *Permission of instructor.* A maximum of 6 credits of 490 may be used toward graduation. Independent work in food science, nutrition, or dietetics.

- A. Dietetics
- B. Food Science
- C. Nutrition
- H. Honors

FS HN 491. Supervised Work Experience. Cr. arr. F.S.S.S. Prereq: *Advance approval of instructor, adviser, and department chair.* A maximum of 3 credits of 491 may be used toward graduation. Supervised off-campus work experience relevant to the academic major. Offered on a satisfactory-fail grading basis only.

- A. Dietetics
- B. Food Science
- C. Nutrition
- D. Community Dietetics

FS HN 496. Food Science and Human Nutrition Travel Course. (Dual-listed with 596.) Cr. 2 to 3. May be repeated. (One credit per week traveled.) S. Prereq: Permission of instructor. Limited enrollment. Tour and study of food industry, dietetic and nutritional agencies in different regions of the world. Pre-tour session arranged. Tour expenses paid by students. Field trip fee.
A. International tour
B. Domestic tours

FS HN 498. Cooperative Education. Cr. R. F.S.SS. Prereq: *Permission of the department chair; senior classification.* Required of all cooperative education students. Students must register for these courses prior to commencing each work period.

FS HN 499. Undergraduate Research. Cr. arr. F.S.SS. Prereq: *Permission of staff member with whom student proposes to work.* A maximum of 6 credits of 499 may be used toward graduation. Research under staff guidance.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

FS HN 500. Short Course. Cr. arr. F.S.SS. Prereq: *Permission of instructor.*
A. Nutrition
B. Food Science

FS HN 502. Advanced Food Science-Chemistry. (1-0) Cr. 1. S. Prereq: *3 credits in organic chemistry.* Key principles and applications in the chemistry of food.

FS HN 503. Advanced Food Science-Processing. (1-0) Cr. 1. S. Prereq: *3 credits each in physics and mathematics.* Key principles and applications in the processing of food.

FS HN 504. Advanced Food Science-Microbiology. (1-0) Cr. 1. S. Prereq: *3 credits each in microbiology and organic chemistry.* Key principles and applications in the microbiology of food.

FS HN 506. Sensory Evaluation of Food. (Dual-listed with 406.) (2-3) Cr. 3. F. Prereq: *214 or 311 or An S 360; 3 credits in statistics.* Sensory test methods and procedures used to evaluate the flavor, color and texture of foods. Relationships between sensory and instrumental measurements of color and texture. Acceptance and preference testing. Materials fee.

FS HN 507. Microbial Safety of Food. (Same as Micro 507.) See *Microbiology.*

FS HN 512. Food Product Development. (Dual-listed with 412.) (2-6) Cr. 4. S. Prereq: *311 or 411, 471.* Principles of developing consumer packaged food products. Application of skills gained in food chemistry, formulation, microbiology, and processing. Some pilot plant experiences. Electronic communication from web emphasized for class reports, notes and assignments. Materials fee.

FS HN 519. Food Toxicology. (Same as Tox 519.) (3-0) Cr. 3. Alt. F., offered 2000. Prereq: *A course in biochemistry.* Basic principles of toxicology. Toxicants in the food supply: modes of action, toxicant defense systems, toxicant/nutrient interactions, risk assessment.

FS HN 525. Food Biotechnology. (Dual-listed with 425; same as Micro 525.) (2-3) Cr. 3. Alt. S., offered 2001. Prereq: *Micro 201L, 302; a course in biochemistry.* Introduction to genetic engineering and fermentation technology and their applications in the food industry; immunological and DNA detection methods; bioethics. Laboratories include all steps in production of a recombinant food enzyme from genetic engineering through fermentation, recovery and characterization. Field trip fee. Materials fee.

FS HN 542. Introduction to Molecular Biology Techniques. (Same as Zool 542.) See *Zoology and Genetics.*

FS HN 543. Medical Dietetics II. (1-6) Cr. 3. F.SS. For students enrolled in the dietetics internship. Discussion of the assessment, diagnosis, intervention, and outcomes of nutritional problems in complex medical conditions with supervised practice experience.

FS HN 547. Biological Applications of Microscopy. (Same as An S 547.) See *Animal Science.*

FS HN 560. Advanced Nutrition. (4-0) Cr. 4. S. Prereq: *BBMB 420 or BBMB 404 and credit or enrollment in BBMB 405.* Principles of the science of nutrition. Energy, carbohydrates, lipids, proteins, minerals, vitamins, nutritional interactions, metabolic consequences of nutritional manipulation.

FS HN 561. Disease and Medical Nutritional Therapy I. (Dual-listed with 461.) (3-2) Cr. 4. F. Prereq: *362 or 560, 3 credits in physiology.* Pathophysiology of selected medical problems with specific attention to nutrition needs and treatment as part of medical nutrition therapy. Clinical nutrition applications in acute and chronic disease. Assessment of nutritional problems, nutrition care, planning and documentation.

FS HN 562. Assessment of Nutritional Status. (3-0) Cr. 3. Alt. S., offered 2000. Prereq: *FS HN 461 or 560.* Overview and practical applications of methods for assessing nutritional status, including: theoretical framework of nutritional health and disease, dietary intake, biochemical indices, clinical examination, and body composition.

FS HN 564. Disease and Medical Nutrition Therapy II. (Dual-listed with 464.) (2-3) Cr. 3. S. Prereq: *561.* Pathophysiology of selected disease states and medical problems. Specific attention will be directed to nutrition needs and treatment of each disease state. Clinical nutrition applications in acute and chronic disease. Assessment of nutritional problems, nutrition care, planning, and documentation.

FS HN 565. Malnutrition in Developing Countries. (2-0) Cr. 2. Alt. S., offered 2001. Prereq: *360 or credit or enrollment in 560.* Identification and quantitative assessment of malnutrition in developing countries. Social, political, economic, and geographic ecology of malnutrition and its impact on health. Protein-energy malnutrition. Vitamin and mineral deficiencies. Intervention organizations, programs, and efforts.

FS HN 572. Food Processing Laboratory. (Dual-listed with 472.) (1-3) Cr. 2. F. Prereq: *503 or equivalent.* Pilot plant experiences in thermal processing, food fermentation, oil seed processing, food extrusion. Assist with the set-up, operations, and data analysis of at least one laboratory exercise. Materials fee.

FS HN 575. Processed Foods. (3-0) Cr. 3. F. Prereq: *214 or 311; a course in nutrition.* Survey of the effects of home and commercial food preparation and processing on the nutrients in food.

FS HN 580. Orientation to Nutrition Research. (1-0) Cr. 1. F. Presentation of nutrition faculty research interests and discussion of selected reading. Intended for entering students in the Nutrition Graduate Program.

FS HN 581. Seminar. (1-0) Cr. 1. F. Training seminar for new students in oral presentation of scientific data. Offered on a satisfactory-fail grading basis only.

FS HN 590. Special Topics. Cr. arr. F.S.SS. Prereq: *Permission of instructor.*
A. Nutrition
B. Food Science
C. Teaching

593. Workshop. Cr. arr. F.S.SS. Prereq: *Permission of instructor.*

FS HN 596. Food Science and Human Nutrition Travel Course. (Dual-listed with 496.) Cr. 2 to 3. May be repeated. (One credit per week traveled.) S. Prereq: *Permission of instructor.* Limited enrollment. Tour and study of food industry, dietetic and nutritional agencies in different regions of the world. Presentation of selected topics. Pre-tour session arranged. Tour expenses paid by students. Field trip fee.

A. International tours
B. Domestic tours

Courses for Graduate Students

FS HN 606. Instrumental Measurement of Food Quality. (2-3) Cr. 3. Alt. F., offered 2000. Prereq: *311 or 411 or 502 or BBMB 404.* Principles of instrumental color measurement. Rheological techniques and instrumentation for measuring the mechanical prop-

erties of foods; relationship of these properties to food textural qualities. Isolation and identification of food flavors. Materials fee.

FS HN 610. Food Enzymology. (2-3) Cr. 3. Alt. F., offered 2000. Prereq: *311 or 411 or 502 or BBMB 404.* Properties of enzymes important in food processing and production. Experimental determination and quantitative evaluation of the influence of concentration of substrates, enzyme, and inhibitors, pH and temperature. Specificity and mechanisms important to food and agricultural biochemistry. Materials fee.

FS HN 612. Food Lipids. (3-0) Cr. 3. Alt. S., offered 2000. Prereq: *311 or 411 or 502 or BBMB 404.* Structure and analysis of food lipids, glyceride structure, crystal form and texture, autooxidation, refining and processing of fats and oils, food applications of fats and oils. Materials fee.

FS HN 613. Food Proteins. (3-0) Cr. 3. Alt. F., offered 1999. Prereq: *311 or 411 or 502 or BBMB 404.* Properties of proteins found in milk, eggs, meat, legumes, and cereal grains. Effect of processing on food proteins.

FS HN 614. Carbohydrates in Foods. (3-0) Cr. 3. Alt. S., offered 2001. Prereq: *311 or 411 or 502 or BBMB 404.* Study of production of carbohydrates used in foods, changes they undergo during processing and storage of food, and relation of their functions to their chemical and physical properties.

FS HN 618. Advanced Nutrition - Minerals and Vitamins. (Same as An S 618.) (3-0) Cr. 3. Alt. F., offered 1999. Prereq: *BBMB 405.* Role of vitamins and minerals in mammalian intermediary metabolism. Integration of cellular biochemistry and physiology of vitamins and minerals.

FS HN 626. Advanced Food Microbiology. (Same as Micro 626, Tox 626.) (2-2) Cr. 3. Alt. S., offered 2000. Prereq: *420 or 421 or 504.* Topics of current interest in food microbiology, including new food-borne pathogens, rapid identification methods, effect of food properties and new preservation techniques on microbial growth, and mode of action of antimicrobials. Materials fee.

FS HN 660. Regulation of Human Energy Metabolism. (3-0) Cr. 3. Alt. F., offered 2000. Prereq: *560; BBMB 404-405 or 420 or equivalent, graduate level course in physiology.* Advanced study of the utilization of various carbohydrates, lipids, and proteins of importance in human nutrition that influences energy status and metabolism. Emphasis will be on the regulatory mechanisms impacted by dietary change during different physiological states.

FS HN 665. Selected Topics in Nutrition. (2-0) Cr. 2 each time taken. Alt. F., offered 1999. Prereq: *560; graduate course in physiology.* Series of courses on such topics as proteins, vitamins, minerals, lipids, energy metabolism, evaluation of nutritional status. Classical and current research literature in each area.

FS HN 680. Modern Views of Nutrition. (Same as An S 680.) See *Animal Science.*

FS HN 681. Seminar. (1-0) Cr. 1. F.S.SS. Presentation of thesis or dissertation research. May be taken once for M.S. program and twice for the Ph.D. program.

FS HN 690. Special Problems. Cr. var. F.S.SS. Prereq: *502 or 503 or 504 or 560.*

FS HN 695. Grant Proposal Writing. (1-0) Cr. 1. F. Prereq: *3 credits of graduate course work in food science and/or nutrition.* Grant proposal preparation experiences including writing and critiquing of proposals and budgets planning. Formation of grant writing teams in food science and/or in nutrition area. Offered on a satisfactory-fail grading basis only.

FS HN 699. Research. Cr. var. F.S.SS.
A. Nutrition
B. Food Science

Foreign Languages and Literatures

Madeleine M. Henry, Chair of Department

Professors: Bernard, Courteau, Dow, Lacasa, Morris, Ruebel

Professors (Emeritus): Bruner, Frink

Associate Professors: Bratsch-Prince, Henry, Lacasa, Lathers, Leonard, Mariner, Matibag, Nabrotzky, Rectanus, Thogmartin, Valdes

Associate Professors (Emeritus): Dial

Assistant Professors: Andres, Bargetto-Andres, Bowles, Jura, Mattson, McGlew, Mook, Thomas

Assistant Professors (Adjunct): Klinkenborg, Li, Lorenzo-Lorenzo, Petrakis, Rosenbusch, Spektor

Assistant Professors (Emeritus): Johnson

Instructors (Adjunct): Hutter

Undergraduate Study

Foreign language study should be a part of the program of most students. The theoretical understanding of and practical experience in language underlie many intellectual disciplines that try to meet the complex problems of contemporary society. Courses offered by the Department of Foreign Languages and Literatures are designed to offer students an understanding of a second culture through the language spoken by that culture, as well as a sound and thorough knowledge of the fundamentals of the language itself.

Graduates will achieve both linguistic proficiency and cultural literacy through the study of the language and culture of their program. Linguistic proficiency entails the ability to function effectively in the target language and the ability to communicate competently with native speakers of the target language. (This will vary somewhat for students of Latin and Ancient Greek.) Cultural literacy includes a general knowledge of the culture's history, familiarity with its literature, and basic knowledge of its social and political institutions.

The department offers both majors and minors in French, German, Russian Studies, and Spanish, leading to the bachelor of arts degree, minors in Latin and Portuguese, and instruction in Chinese, Italian and Classical Greek. A minor in any foreign language requires at least 15 credits, nine of which must be at the 300 level or higher. Of these, 3 credits must be in literature or culture. Courses numbered in the 370s may not be used toward the minor or major except in Russian Studies. A full statement of requirements for the major in each language may be obtained from the department. For a complete statement of all the college degree requirements, see *Liberal Arts and Sciences, Curriculum*. Current and detailed information about the department, including placement information, is available on-line at www.pub.lic.iastate.edu/~flng_info/homepage.html.

Students who have had formal training in foreign languages offered at Iowa State may obtain credit by passing appropriate examinations. Students with native fluency in languages taught at Iowa State may not enroll in or test out of elementary or intermediate courses (100 and 200 level) in their native language. (Students have native fluency if their ethnic first language as indicated on the matriculation form is the language in which they wish to enroll. Students are also considered to have native fluency if they have had substantial attendance at a secondary school or university where the language of instruction is the language in which they wish to enroll at ISU.) Students with native fluency may be eligible to enroll in literature and civilization courses in their native language at the 300 level or above, or receive credit for such courses by passing an appropriate examination; such students must also consult the department office to determine eligibility for advanced composition and conversation courses (300 level and above).

Students who have completed three or more years of French, German, or Spanish in high school may not receive graded credit for 101-102, 110 or 160 in those languages; test-out credit (T-credit) may be obtained by passing an appropriate examination or by completing an advanced sequence (200-level or higher) in that language. If these students choose to take 101-102 on a remedial basis, they will be graded S-F.

Credit by examination (test-out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is not normally available.

The Department of Foreign Languages and Literatures participates in the Iowa Board of Regents' foreign language summer programs in Austria and France. The Department also offers summer programs in Russia, Spain and Mexico; and a semester program in Mexico and Spain. Information concerning these programs can be obtained directly from the department. The department also houses the Classical Studies Program.

Language and literature courses numbered 300 and above are principally taught in the target language; courses numbered in the 370s are taught in English. For courses taught in English about Classical Greek or Latin, see Classical Studies. Students may not take elementary or intermediate (100/200 level) courses for credit after successfully completing any advanced (300/400 level) course except those in the 370 series, or German 471, 472 (courses taught in English translation). Students who have successfully completed any course in the elementary/intermediate (100/200 level) sequence may not take a lower-numbered course in that sequence for a grade.

Courses numbered 110 and 160 are essentially equivalent to 101 and 102 combined; credit toward graduation may not be acquired in more than one of these options.

Students at all levels of foreign language study will have access to the Language Learning Resource Center, located in 312 Pearson. The resource center contains an extensive collection of foreign language materials, including films, music, books, computer software and hardware, and course-related materials.

English proficiency requirement: The department requires a grade of C- or better in each of Engl 104 and 105 (or 105H), and a grade of C or better in any course taught by the Department of Foreign Languages and Literatures or the interdepartmental program in classical studies numbered 370 through 375.

Graduate Study

The Department of Foreign Languages offers a graduate minor in French, German, Latin, Russian and Spanish. The graduate minor in each of these languages is designed to provide an opportunity for graduate students to further their knowledge of that language to complement work in their major disciplines. The graduate minor provides formal recognition of student achievement and expertise in one of the languages above. Graduate minor credits are also offered in Greek and Portuguese.

Graduate Minor

Program Requirements:

a. **Prerequisites:** Graduate students who wish to minor in one of the languages above must have 400-level proficiency in that language. When this is not the case, the student may be required to take a language course below the 400-level, which would not count towards the graduate minor requirements.

b. **Course Requirements:** For the M.A. or M.S.: Three courses in the language of the minor. No more than three credits may be in courses numbered 401, 402, and 403. For the Ph.D.: Four courses in the language of the minor which must include at least one three credit course at the 500 level. No more than three credits may be in courses numbered 401, 402, or 403. At least two courses for the M.A. and the Ph.D. minors must be taken in residence at Iowa State University. Papers written for these courses are expected to have a content and depth commensurate with the graduate status of the student.

Courses open for nonmajor graduate credit: Chin 490; F Lng 492, 498; Frnch 401, 440, 441, 442, 480, 490, 491, 493; Ger 440, 441, 442, 471, 472, 490, 493; Greek 490; Ital 490; Latin 441, 442, 490; Port 340, 341, 440, 441, 490, 580; Rus 401, 402, 422, 441, 442, 480, 490; Span 326, 330, 331, 332, 350, 351, 370, 401, 403, 440, 441, 442, 443, 444, 445, 480, 490, 493, 494, 495, 496, 497, 580, 590, 690.

Courses Primarily for Undergraduate Students

Chinese (Chin)

Chin 101. Elementary Mandarin Chinese I. (5-1) Cr. 5. F. Introduction to spoken and written colloquial Mandarin through pinyin and traditional characters. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and

202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Chin 102. Elementary Mandarin Chinese II. (5-1) Cr. 5. S. *Prereq:* 101. Introduction to spoken and written colloquial Mandarin through pinyin and traditional characters. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Chin 201. Intermediate Mandarin Chinese I. (5-1) Cr. 5. F. *Prereq:* 102. Development of speaking, writing, reading, and listening skills. Review and expansion of grammar skills, introduction to simplified characters and dictionaries; intensification of character acquisition. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Chin 202. Intermediate Mandarin Chinese II. (5-1) Cr. 5. S. *Prereq:* 201. Development of speaking, writing, reading, and listening skills. Review and expansion of grammar skills, introduction to simplified characters and dictionaries; intensification of character acquisition. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course.

Chin 370. Topics in Chinese Literature. (3-0) Cr. 3. F. *Prereq:* *Engl 105 or equivalent.* Chinese literature in translation. Topics may include traditional prose, poetry, and drama; the Chinese novel; twentieth-century fiction and film; gender and cosmology in Chinese literature. All readings and class discussions in English.

Chin 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* 6 credits in Chinese and permission of department chair. Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. Nonmajor graduate credit.

French (Frnch)

Majors in French are required to complete the following core courses: 301-302, 321-322, 331-332 and six credits chosen from the following 401, 440, 441, 442, 480, 491. Nine additional credits are required for the literature concentration or the language/pedagogy concentration; six additional credits are required for the interdisciplinary studies concentration.

Frnch 101. Elementary French I. (4-1) Cr. 4. F. Beginning level development of reading, writing, listening comprehension, and speaking in French, within the context of French culture. Use of audiovisual materials. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Frnch 102. Elementary French II. (4-1) Cr. 4. S. *Prereq:* 101. Beginning level development of reading, writing, listening comprehension, and speaking in French, within the context of French culture. Use of audiovisual materials. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Frnch 110. Intensive Elementary French. Cr. 8. SS. Equivalent to 101, 102 combined, offered summer only. Materials fee.

Frnch 201. Intermediate French I. (3-0) Cr. 3. F. *Prereq:* 102, 110; concurrent enrollment in 205 recommended. Intermediate level development of reading, writing, listening comprehension, and speaking in French within the context of French culture. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Frnch 202. Intermediate French II. (3-0) Cr. 3. S. *Prereq:* 201; concurrent enrollment in 206 recommended. Intermediate level development of reading, writing, listening comprehension, and speaking in French within the context of French culture. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Frnch 205. Intermediate Conversation. (3-0) Cr. 3. F. *Prereq:* Credit or enrollment in 201 or 202. Practice in basic oral communication skills within the context of French culture. May be taken concurrently with 301. Materials fee.

Frnch 206. Intermediate Conversation. (3-0) Cr. 3. S. *Prereq:* Credit or enrollment in 201 or 202. Practice in basic oral communication skills within the context of French culture. May be taken concurrently with 302. Materials fee.

Frnch 301. Grammar Review and Composition. (3-0) Cr. 3. F. *Prereq:* 202; concurrent enrollment in 305 recommended. Intensive grammar review. Compositions and reading of literary and cultural texts. Materials fee.

Frnch 302. Reading and Composition. (3-0) Cr. 3. S. *Prereq:* 301. Critical reading of literary and cultural texts. Analysis of texts in compositions. Materials fee.

Frnch 305. Advanced Conversation. (3-0) Cr. 3. F. *Prereq:* Credit or enrollment in 301 recommended. Intensive conversational and listening practice. Communicative study of French culture. Materials fee.

Frnch 321. French Civilization. (3-0) Cr. 3. F. *Prereq:* 302. French civilization from its origins through the French Revolution. Materials fee.

Frnch 322. French Civilization. (3-0) Cr. 3. S. *Prereq:* 302. French civilization from the Napoleonic era to the present. Materials fee.

Frnch 331. Survey of French Literature. (3-0) Cr. 3. F. *Prereq:* 302. French literature from the Middle Ages through the eighteenth century. Introduction to textual analysis. Materials fee.

Frnch 332. Survey of French Literature. (3-0) Cr. 3. S. *Prereq:* 302. French literature of the nineteenth and twentieth centuries. Introduction to textual analysis. Materials fee.

Frnch 370. French Studies in English. (3-0) Cr. 3. Topics vary according to student and faculty interest. Author, genre or period study such as Francophone literature, women writers, cinema, or contemporary theory. Readings, discussions, and papers in English. When content is appropriate, may be taken as W S 370f. May be repeated up to a maximum of 6 credits. Materials fee.

Frnch 375. Contemporary France. (3-0) Cr. 3. Readings, discussions, and papers in English on contemporary thought, politics, history, anthropology, arts, etc. Materials fee.

Frnch 395. Study Abroad. Cr. 1 to 10. *Prereq:* 2 years university-level French. Supervised instruction in language and culture of France; formal class instruction at level appropriate to student's training, augmented by practical living experience.

Frnch 401. Writing French. (3-0) Cr. 3. F. *Prereq:* 302. Development of advanced writing skills, using a wide range of exercises and writing assignments in a variety of contexts. Review of selected grammar and syntax. Nonmajor graduate credit.

Frnch 440. Topics in French Studies. (3-0) Cr. 3. *Prereq:* 331 or 332. Area studies in French or francophone literature or civilization. Possible topics: women writers, cinema, Paris. May be repeated. Nonmajor graduate credit.

Frnch 441. Topics in Medieval, 16th, or 17th-Century Literature. (3-0) Cr. 3. *Prereq:* 331 or 332. Studies of periods, genres, literary trends, or individual authors. May be repeated. Nonmajor graduate credit.

Frnch 442. Topics in 18th, 19th, or 20th-Century Literature. (3-0) Cr. 3. *Prereq:* 331 or 332. Studies of periods, genres, literary trends, or individual authors. May be repeated. Nonmajor graduate credit.

Frnch 480. Seminar in French Literature or Civilization. (3-0) Cr. 3. *Prereq:* 331 or 332. Study of a selected topic in literature, literary criticism, or civilization. May be repeated. Nonmajor graduate credit.

Frnch 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* Permission of French staff and department chair. No more than 9 credits in 490 may be counted toward graduation. Designed to meet the needs of students who wish to focus on areas other than those in which courses are offered. Nonmajor graduate credit.

Frnch 491. French Linguistics. (Same as Ling 491.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* Credit or enrollment in 301, Ling 219 recommended. An introduction to French linguistics and its applications in teaching French. Phonetics, phonology, morphology, and syntax of French. Social and regional variations in the language. Nonmajor graduate credit.

Frnch 493. Workshop in Second-Language Teaching (French). (1-3) Cr. 1 to 3. SS. *Prereq:* Experience in teaching French. Professional-level skills improvement in spoken and written French. Current trends in teaching French language and culture. Nonmajor graduate credit.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Frnch 590. Special Topics in French. Cr. 2 to 4 each time taken. *Prereq:* Permission of instructor; 6 credits of 400 level French. Nonmajor graduate credit.

- A. Literature or Literary Criticism
- B. Linguistics
- C. Language Pedagogy
- D. Civilization

German (Ger)

Majors in German are required to complete at least 30 credits beyond the intermediate (201-202) level. Courses required for the German major are: 301, 302, 305; 330 or 340; 471, 472 (4 cr. each), and at least one from 440, 441, 442 for 4 cr.

Ger 101. Elementary German I. (4-1) Cr. 4. F. Introduction to German language within the context of German culture; practice in the basic skills. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Ger 102. Elementary German II. (4-1) Cr. 4. S. *Prereq:* 101. Continuation of German 101. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Ger 110. Intensive Elementary German. Cr. 8. SS. Equivalent to 101, 102 combined, offered summer only. Materials fee.

Ger 201. Intermediate German I. (4-1) Cr. 4. F. *Prereq:* 102 or 110. Review of grammar, selected readings, further practice in oral and written communication. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Ger 202. Intermediate German II. (4-1) Cr. 4. S. *Prereq:* 201. Continuation of German 201. One section will emphasize the use of German in professional contexts. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Ger 301. Reading. (3-0) Cr. 3. F. *Prereq:* 202. Emphasis on the development of reading skills through a variety of text types from contemporary German society; review of advanced grammar. Materials fee.

Ger 302. Composition. (3-0) Cr. 3. S. *Prereq:* 301. Emphasis on writing skills, with further development of grammar and reading skills. Materials fee.

Ger 305. Advanced Conversation and Listening Comprehension. (3-0) Cr. 3. F. *Prereq:* 202, concurrent enrollment in 301 recommended. Intensive conversational and listening practice in German. Materials fee.

Ger 330. Introduction to German Literature. (3-0) Cr. 3. S. *Prereq:* 301. Selected readings in German literature from Classicism to present. Emphasis on techniques of reading and analysis of literary texts. Materials fee.

Ger 340. Germany Today. (3-0) Cr. 3. S. *Prereq:* 301. Selected topics dealing with contemporary German society and culture. Introduction to materials, resources, and forms of communication available on the Internet, SCOLA (German-language television), and in other electronic and print media. Materials fee.

Ger 370. German Studies in English. (3-0) Cr. 3. F. Topics vary according to student and faculty interest. Author, genre or period study chosen in light of student and faculty interest. When content is appropriate, may be taken as W S 370g. Materials fee.

Ger 375. Grimm's Tales. (3-0) Cr. 3. Alt. S., offered 2001. Introduction to Germanic antiquities, mythology, and heroic legends; Herder's concept of *Naturpoesie*. Emphasis on the Grimm tales: theoretical approaches to the tales from the late 19th and early 20th centuries; perversions of these traditional tales by the National Socialists (Nazis). Readings in contemporary Grimm scholarship. Taught in English. Materials fee.

Ger 378. German Film and Media Studies. (3-0) Cr. 3. F. Analysis and interpretation of film or media in German society. Study of media production and reception within multicultural and global contexts. Thematic emphases based on faculty and student interest including: 1) film directors, genres, movements (e.g. New German Cinema), aesthetics, and cinematography or 2) media studies (e.g. television, mass press, popular culture). Taught in English. Materials fee.

Ger 395. Study Abroad. Cr. 1 to 10. *Prereq:* 2 years university-level German. Supervised instruction in language and culture of Germany; formal class instruction at level appropriate to student's training, augmented by practical living experience.

Ger 440. Topics in German Literature: Genres. (3-0) Cr. 3 or (4-0) Cr. 4. F. *Prereq:* 302, and either 330 or 340. Fourth credit required for the major. Nonmajor graduate credit.

Ger 441. Topics in German Literature: Periods. (3-0) Cr. 3, or (4-0) Cr. 4. Alt. S. Offered 2001. *Prereq:*

302, and 330 or 340. Fourth credit required for the major. Nonmajor graduate credit

Ger 442. Topics in German Literature: Themes. (3-0) Cr. 3, or (4-0) Cr. 4. Alt. S. Offered 2000. *Prereq:* 302, and 330 or 340. Fourth credit required for the major. Nonmajor graduate credit.

Ger 471. Foundations of German Civilization. (3-0) Cr. 3 or (3-1) Cr. 4. F. *Prereq:* Engl 105 and for fourth credit Ger 302, and 330 or 340. Study of various aspects of German history and culture prior to 1800, e.g., German tribes, Christianization, the Middle Ages, Reformation, the rise of Prussia. Taught in English. Fourth credit: supplementary readings and compositions in German. Nonmajor graduate credit.

Ger 472. Topics in German Cultural Studies. (3-0) Cr. 3 or (3-1) Cr. 4. S. *Prereq:* Engl 105 and for fourth credit Ger 302, 330, or 340. German history and culture from 1800 to the present. Thematic emphases including: revolutions, unifications, National Socialism, the Holocaust, Germany and the European Union, national identity, cultural politics, urban culture, media, multiculturalism, technology, and the environment. Taught in English. Fourth credit: supplementary readings and compositions in German. Nonmajor graduate credit.

Ger 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* 6 credits in German and permission of department chair. No more than 9 credits of Ger 490 may be counted toward graduation. Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields.

Ger 493. Workshop in Second-Language Teaching (German). (1-3) Cr. 1 to 3. SS. *Prereq:* Experience in teaching German. Intensive refresher course in written and oral German. May be repeated to a maximum of 9 credits. Materials fee. Nonmajor graduate credit.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Ger 590. Special Topics in German. Cr. 2 to 4 each time taken. *Prereq:* Permission of instructor; 6 credits of 400 level German. Nonmajor graduate credit.

- A. Literature or Literary Criticism
- B. Linguistics
- C. Language Pedagogy
- D. Civilization

Greek (Greek)

For courses in Greek literature taught in English, see *Classical Studies*.

Greek 101. Elementary Classical Greek I. (4-1) Cr. 4. F. Grammar and vocabulary of ancient Attic Greek, within the context of Greek culture; reading knowledge through texts adapted from classical authors. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Greek 102. Elementary Classical Greek II. (4-1) Cr. 4. S. *Prereq:* 101. Grammar and vocabulary of ancient Attic Greek, within the context of Greek culture; reading knowledge through texts adapted from classical authors. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Greek 201. Intermediate Classical Greek. (4-1) Cr. 4. F. *Prereq:* 102. Comprehensive review of grammatical principles; emphasis on reading unadapted classical or Hellenistic texts. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled

in the course. Credit by examination for other courses in the department is normally not available.

Greek 306. Classical Greek Prose Composition. (2-0) Cr. 2. S. *Prereq:* 201, concurrent enrollment in 342. Practice in expressive writing with emphasis on styles and idiomatic usage. May be repeated once for credit.

Greek 342. Introduction to Classical Greek Literature. (3-0) Cr. 3. S. *Prereq:* 201. Masterworks of ancient Greek literature with emphasis on critical analysis of style, structure, or thought. Materials fee.

Greek 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* 6 credits in Greek and permission of department chair. No more than 9 credits of Greek 490 may be counted toward graduation. Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. Nonmajor graduate credit.

Italian (Ital)

Ital 101. Elementary Italian I. (4-1) Cr. 4. F. Introduction to basic grammar and structure of the language; use of audio materials supplemented by graded reading within the context of Italian culture. Especially recommended as a second area of language study for majors in French and Spanish. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Ital 102. Elementary Italian II. (4-1) Cr. 4. S. *Prereq:* 101. Introduction to basic grammar and structure of the language; use of audio materials supplemented by graded readings within the context of Italian culture. Especially recommended as a second area of language study for majors in French and Spanish. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Ital 201. Intermediate Italian I. (4-1) Cr. 4. Offered as demand warrants. *Prereq:* 102. Review of first-year principles and expanded study of grammar; development of written and spoken skills; introduction to Italian civilization and literature through extracts from noted authors. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Ital 202. Intermediate Italian II. (4-1) Cr. 4. Offered as demand warrants. *Prereq:* 201. Review of first-year principles and expanded study of grammar; development of written and spoken skills; introduction to Italian civilization and literature through extracts from noted authors. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Ital 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* 6 credits in Italian and permission of department chair. No more than 9 credits in Ital 490 may be counted toward graduation. Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. Nonmajor graduate credit.

Latin (Latin)

For courses in Latin literature taught in English, see *Classical Studies*.

Latin 101. Elementary Latin I. (4-1) Cr. 4. F. Grammar and vocabulary of classical Latin, within the context of Roman culture; reading knowledge through texts adapted from classical authors. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Latin 102. Elementary Latin II. (4-1) Cr. 4. S. *Prereq:* 101. Grammar and vocabulary of classical Latin, within the context of Roman culture; reading knowledge through texts adapted from classical authors. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Latin 201. Intermediate Latin. (4-1) Cr. 4. F. *Prereq:* 102. Review of grammatical principles; emphasis on reading unadapted texts from the Late Republic or Early Empire. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Latin 306. Composition and Oral Interpretation. (2-0) Cr. 2. S. *Prereq:* 201, concurrent enrollment in 342. Practice in composition, and in expressive reading of literary texts. Emphasis on sensitivity to style, idiomatic usage, and effective written and oral expression. Compositions based on readings in 342. May be repeated once for credit. Materials fee.

Latin 342. Introduction to Latin Literature. (3-0) Cr. 3. S. *Prereq:* 201. Masterworks of Latin prose or poetry with emphasis on techniques of literary and historical criticism. Materials fee.

Latin 441. Advanced Readings in Latin. (3-0) Cr. 3. F. *Prereq:* 342. Study of individual authors or genres; intensive readings in the original supplemented by modern criticism and analysis in English. Authors and genres will vary; courses may be repeated to a maximum of 6 credits each. Nonmajor graduate credit.

Latin 442. Advanced Readings in Latin. (3-0) Cr. 3. S. *Prereq:* 342. Study of individual authors or genres; intensive readings in the original supplemented by modern criticism and analysis in English. Authors and genres will vary; courses may be repeated to a maximum of 6 credits each. Nonmajor graduate credit.

Latin 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* 6 credits in Latin and permission of department chair. No more than 9 credits in Latin 490 may be counted toward graduation. Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. Nonmajor graduate credit.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Latin 590. Special Topics in Latin. Cr. 2 to 4 each time taken. *Prereq:* Permission of instructor; 6 credits of 400 level Latin.

- A. Literature or Literary Criticism
- B. Linguistics
- C. Language Pedagogy
- D. Civilization

Portuguese (Port)

Port 101. Elementary Brazilian Portuguese I. (4-1) Cr. 4. Alt. F., offered 2000. Introduction through the conversational approach within the context of Luso-Brazilian culture. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 211 is available only to students who are not currently enrolled in the course. Credit by exami-

nation for other courses in the department is normally not available.

Port 102. Elementary Brazilian Portuguese II. (4-1) Cr. 4. Alt. S., offered 2001. *Prereq:* 101. Introduction through the conversational approach within the context of Luso-Brazilian culture. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 211 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Port 211. Intermediate Conversation. (4-0) Cr. 4. Alt. F., offered 1999. *Prereq:* 102 or equivalent. Intensive conversation, review of grammar, practice in writing, reading of short original pieces. All work in Portuguese. Materials fee.

Port 340. Brazilian Civilization and Culture. (3-0) Cr. 3 each time taken. Alt. S., offered 2000. *Prereq:* 211 or equivalent. Introduction to Brazilian civilization and culture through the study of historical and literary texts. Readings, discussion, and papers in Portuguese. Materials fee. Nonmajor graduate credit.

Port 341. Portuguese Civilization and Culture. (3-0) Cr. 3 each time taken. Alt. F., offered 2000. *Prereq:* 211 or equivalent. Culture of Portugal and Lusophone Africa through the study of Portuguese cultural and literary texts. Readings, discussion, and papers in Portuguese. Materials fee. Nonmajor graduate credit.

Port 370. Portuguese Language Literature in English Translation. (3-0) Cr. 3. Study of a particular period, theme, genre, or author. Topics chosen according to student and faculty interests. Readings, discussion, and written work in English. May be repeated for a maximum of 6 credits. Materials fee. Nonmajor graduate credit.

Port 440. Advanced Readings in Brazilian Literature. (3-0) Cr. 3 each time taken. Alt. S., offered 2001. *Prereq:* 211 or equivalent. Study of individual authors, genres, or periods. Intensive readings of original Brazilian texts supplemented by theoretical readings in English. Authors, genres, and periods will vary. Readings, discussion, and papers in Portuguese. Nonmajor graduate credit.

Port 441. Advanced Readings in Portuguese and African Literature. (3-0) Cr. 3 each time taken. Alt. F., offered 2001. Intensive readings of Lusophone texts from Africa and Portugal. Theory readings in English. Discussion and papers in Portuguese. Nonmajor graduate credit.

Port 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* 6 credits in Portuguese and permission of department chair. No more than 9 credits in Port 490 may be counted toward graduation. Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. Nonmajor graduate credit.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Port 580. Graduate Seminar in Lusophone Literature or Culture. Cr. 1 to 3. F.S.SS. *Prereq:* 6 credits of 300 level Portuguese. Topics vary. Nonmajor graduate credit.

Port 590. Special Topics in Portuguese. Cr. 1 to 4 each time taken. *Prereq:* Permission of instructor; 6 credit of 300 level Portuguese. Nonmajor graduate credit.

- A. Brazilian Literature or Culture
- B. Linguistics and Language Pedagogy
- C. Lusophone Literature or Culture of Portugal or Africa

Russian (Rus)

Majors in Russian Studies are required to complete 30 credits beyond the intermediate (201, 202) level. Required: Rus 301 and 302 or equivalent, and Rus 480 (9 credits total).

The remaining 21 hours are selected from the following: Hist 421, 422, and 426; Pol S 349, 355; Relig 363; Rus 351, 370, 375, 376, 401, 402, 422, 441, 442, 490, and 590.

Rus 101. Elementary Russian I. (4-1) Cr. 4. F. Introduction to the Russian language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Russian culture. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Rus 102. Elementary Russian II. (4-1) Cr. 4. S. *Prereq:* 101. Introduction to the Russian language, grammar and syntax. Practice in the four basic skills (listening, speaking, reading, and writing) within the context of Russian culture. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Rus 201. Intermediate Russian I. (4-1) Cr. 4. F. *Prereq:* 102. Thorough review of grammar and growth of vocabulary. Selected readings. Continued use of the four basic skills. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Rus 202. Intermediate Russian II. (4-1) Cr. 4. S. *Prereq:* 201. Thorough review of grammar and growth of vocabulary. Selected readings. Continued use of the four basic skills. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Rus 301. Composition and Conversation I. (3-0) Cr. 3. F. *Prereq:* 202. Thorough study of the Russian language, with emphasis on strengthening proficiency in writing, speaking, reading, and listening. Increased focus on syntax and word formation. Materials fee.

Rus 302. Composition and Conversation II. (3-0) Cr. 3. S. *Prereq:* 301. Thorough study of the Russian language, with emphasis on strengthening proficiency in writing, speaking, reading, and listening. Increased focus on syntax and word formation. Materials fee.

Rus 351. Russian for Professionals. (3-0) Cr. 3. Alt. F. *Prereq:* 202. Designed to meet the needs of students who desire to integrate a study of Russian language with special problems in science and business. Emphasis on scientific or business language. Increased focus on reading, grammar, and standards for writing scholarly papers or business documents. Materials fee.

Rus 370. Russian Literature in English Translation. (3-0) Cr. 3. Study of a particular period, theme, genre, or author. Topics chosen in light of student and faculty interests. Readings, discussions, and written work in English. May be repeated for a maximum of 6 credits. Materials fee.

Rus 375. Russian Civilization. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 202. Survey of Russian cultural history from 988 to 1855. Taught in English.

Rus 376. Russian Civilization. (3-0) Cr. 3. Alt. Yr., offered 2001. S. *Prereq:* 202. Survey of Russian cultural history from 1855 to the present. Taught in English.

Rus 395. Study Abroad. Cr. arr. 1 to 6. *Prereq:* 2 years university-level Russian. Supervised instruction in language and culture of Russia; formal class

instruction at level appropriate to student's training, augmented by practical living experience.

Rus 401. Advanced Composition and Conversation I. (3-0) Cr. 3. F. *Prereq:* 302. Intensive practice in composition and conversation with emphasis on mastery of speaking and writing skills; development of idiomatic usage and effective expression of ideas. Increased emphasis on vocabulary building, grammatical correctness, and compatibility of style and content. Nonmajor graduate credit.

Rus 402. Advanced Composition and Conversation II. (3-0) Cr. 3. S. *Prereq:* 401. Intensive practice in composition and conversation with emphasis on mastery of speaking and writing skills; development of idiomatic usage and effective expression of ideas. Increased emphasis on vocabulary building, grammatical correctness, and compatibility of style and content. Nonmajor graduate credit.

Rus 422. Russian Culture. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 302. Study of a particular period or cultural phenomenon (i.e., cultural pattern, myth, or archetype). Topics selected from history, Russian Orthodox religion, literature, art, theatre, or cinema. Materials fee. Nonmajor graduate credit.

Rus 441. Literary Masterpieces of the Nineteenth and Twentieth Century. (3-0) Cr. 3. F. *Prereq:* 302. Study of representative works by leading authors of the nineteenth and twentieth centuries. Nonmajor graduate credit.

Rus 442. Literary Masterpieces of the Nineteenth and Twentieth Century. (3-0) Cr. 3. S. *Prereq:* 302. Study of representative works by leading authors of the nineteenth and twentieth centuries. Nonmajor graduate credit.

Rus 480. Advanced Seminar in Russian Studies. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 302. Study of a selected topic in history, politics, Russian Orthodox religion, literature, art, theatre, and/or cinema. Materials fee. Nonmajor graduate credit.

Rus 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* 6 credits in Russian and permission of department chair. No more than 9 credits of Rus 490 may be counted toward graduation. Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Rus 590. Special Topics in Russian. Cr. 2 to 4 each time taken. *Prereq:* Permission of instructor; 6 credits of 400 level Russian. Nonmajor graduate credit.

- A. Literature or Literary Criticism
- B. Linguistics
- C. Language Pedagogy
- D. Civilization

Spanish (Span)

Majors in Spanish are required to complete at least 33 credits beyond the intermediate (201-202) level. Majors take the following core courses: 301, 303, 314, 321, 401; two courses from 330, 331, 332; and one from 440, 441, 442, 443, 444, 445 or 480/580. The six remaining credits are chosen from student's choice of emphasis: linguistics, literature, or culture.

Span 101. Elementary Spanish I. (4-1) Cr. 4. F.S. Essentials of construction and vocabulary with an aural-oral approach within the context of Hispanic culture. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Span 102. Elementary Spanish II. (4-1) Cr. 4. F.S. *Prereq:* 101. Continuation of Spanish 101. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is avail-

able only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Span 110. Intensive Elementary Spanish. Cr. 8. SS. Equivalent to 101, 102 combined, offered summer only. Materials fee.

Span 160. Accelerated Beginning Spanish. (8-2) Cr. 8. S.SS. *Prereq:* 2 or more years of study in another foreign language. Rapid introduction to written and spoken Spanish within the context of Spanish culture; accelerated approach to grammar and syntax. Intended for students with proven ability to learn language rapidly. Materials fee.

Span 201. Intermediate Spanish I. (4-1) Cr. 4. F.S. *Prereq:* 102, 110, or 160. Intensive review of basic grammar. Practice in oral and written communication. Development of fluency with idiomatic expressions. Selected readings on culture and literature. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course. Credit by examination for other courses in the department is normally not available.

Span 202. Intermediate Spanish II. (4-1) Cr. 4. F.S. *Prereq:* 201. Continuation of Spanish 201. Intensive review of basic grammar. Practice in oral and written communication. Development of fluency with idiomatic expressions. Selected readings on culture and literature. Materials fee. Credit by examination (test out exams) in the Department of Foreign Languages and Literatures for courses numbered 101, 102, 201, and 202 is available only to students who are not currently enrolled in the course.

Span 301. Spanish Grammar and Composition. (3-0) Cr. 3. F.S. *Prereq:* 202 or 4 years of high school Spanish. Application of grammar concepts in the development of writing and reading skills within the context of Hispanic culture. Materials fee.

Span 303. Spanish Conversation. (3-0) Cr. 3. F.S. *Prereq:* 202 or 4 years of high school Spanish. Intensive oral practice and improvement of oral proficiency. Application of specific grammar concepts for development of conversational skills within the context of Hispanic culture. Materials fee.

Span 307. Composition for Native Speakers. (3-0) Cr. 3. F.S. *Prereq:* Native speaker of Spanish. Development of effective writing skills. Focus on problems in orthography, morphology, and syntax. Emphasis on writing expository and interpretive essays. Reading, writing and discussions in Spanish.

Span 314. Introduction to Reading Hispanic Texts. (3-0) Cr. 3. F.S. *Prereq:* 301, 320 or 326 or 4 years of high school Spanish. Critical reading of Hispanic literary and cultural texts. Presentation of techniques and terminology of literary criticism. Study of basic genres: narrative, poetry, drama, essay. Required as prerequisite for 330, 331 and 332. Materials fee.

Span 320. Introduction to Cultural Readings. (3-0) Cr. 3. F.S. *Prereq:* 202 or 4 years of high school Spanish. Readings may include philosophical essays, mass media materials, and other texts which illustrate cultural differences. Readings, discussions, and compositions in Spanish.

Span 321. Spanish Civilization. (3-0) Cr. 3. F. *Prereq:* 301, 320 or 326. A survey of the art and architecture, the social and political structure, and the cultural heritage of the Hispanic world. Peninsular culture and civilization. Materials fee.

Span 322. Spanish Civilization. (3-0) Cr. 3. S. *Prereq:* 301, 320 or 326. A survey of the art and architecture, the social and political structure, and the cultural heritage of the Hispanic world. Ibero-American culture and civilization. Materials fee.

Span 326. Hispanic Art in a Cultural Context. (3-0) Cr. 3. S. *Prereq:* 202 or 4 years high school Spanish. Survey of major currents and figures in Spanish and Latin American art, alongside selected literary and documentary texts and films. Materials fee. Nonmajor graduate credit.

Span 330. Survey of Spanish Literature to 1700. (3-0) Cr. 3. F. *Prereq:* 314. Highlights of Spanish liter-

ature from the earliest times through Golden Age; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Materials fee. Nonmajor graduate credit.

Span 331. Survey of Spanish Literature from 1700 to the Present. (3-0) Cr. 3. S. *Prereq:* 314. Highlights of Spanish literature from the eighteenth century to the present; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Materials fee. Nonmajor graduate credit.

Span 332. Survey of Latin American Literature. (3-0) Cr. 3. S. *Prereq:* 314. Highlights of Latin American literature from the earliest times to the present; techniques of literary criticism. Lectures, discussion, and analysis of individual selections in Spanish. Materials fee. Nonmajor graduate credit.

Span 350. Spanish for Business and Professions. (3-0) Cr. 3. S. *Prereq:* 202 and permission of instructor. Introduction to basic business terminology within a cultural context. Emphasis on composition and letter writing. Grammar review as needed. Individual projects will focus on special interests. Materials fee. Nonmajor graduate credit.

Span 351. Introduction to Spanish-English Translation. (3-0) Cr. 3. F. *Prereq:* 301, 303 or 350. Introduction to the theory, methods, techniques, and problems of translation. Consideration of material from business, literature, and the social sciences. Materials fee. Nonmajor graduate credit.

Span 370. Spanish Literature in English Translation. (3-0) Cr. 3. Study of a selected period, theme, genre, or author. Readings, discussions, and written work in English. May be repeated for a maximum of 6 credits. Materials fee. Nonmajor graduate credit.

Span 395. Study Abroad. Cr. 1 to 10. *Prereq:* Equivalent to 2 years university-level Spanish. Supervised instruction in Spanish and Hispanic culture; formal class instruction at level appropriate to student's training, augmented by practical living experience.

Span 401. Advanced Composition and Grammar. (3-0) Cr. 3. F. *Prereq:* 301. Advanced study of Spanish grammar and syntax. Students' writing of compositions incorporates an advanced understanding of grammar, syntax, and principles of organization of thought and ideas. Nonmajor graduate credit.

Span 403. Advanced Conversation. (3-0) Cr. 3. S. *Prereq:* 303. Intensive oral practice. Development of fluency in the use of idiomatic expressions and application of grammar and syntax concepts to conversational skills. Emphasis on organization of speeches and other oral presentations. Nonmajor graduate credit.

Span 440. Spanish Literature of the Middle Ages (Beginnings to 1500). (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 330. Discussion and analysis of major trends and figures in Medieval prose, drama, and poetry. May be repeated for a maximum of 6 credits. Nonmajor graduate credit.

Span 441. Literature of the Golden Age (from 1500 to 1700). (3-0) Cr. 3. *Prereq:* 330. Alt. F., offered 1999. Discussion and analysis of major trends and figures in Renaissance and Baroque prose, drama, and poetry. May be repeated for a maximum of 6 credits. Nonmajor graduate credit.

Span 442. Spanish Literature of the 18th and/or 19th Century. (3-0) Cr. 3. *Prereq:* 330, 331 or 332. Alt. S., offered 2001. Discussion and analysis of representative works, authors, and literary trends from Romanticism through Generation '98. May be repeated for a maximum of 6 credits. Nonmajor graduate credit.

Span 443. Spanish Literature of the 20th Century. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 330, 331 or 332. Topics may include such themes as social protest in the post-war novel, modernism and surrealism in poetry and drama, etc. May be repeated for a maximum of 6 credits. Nonmajor graduate credit.

Span 444. Latin American Literature from Earliest Times to Independence. (3-0) Cr. 3. *Prereq:* 330, 331 or 332. Alt. S., offered 2000. Study and analysis

of representative works, literary schools, and movements of this period. May be repeated for a maximum of 6 credits. Nonmajor graduate credit.

Span 445. Latin American Literature from Independence to the Present. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 330, 331 or 332. Critical and analytical study of Latin American prose, poetry, and drama. May be repeated for a maximum of 6 credits. Nonmajor graduate credit.

Span 480. Seminar in Hispanic Literature or Culture. (3-0) Cr. 3 each time taken. Alt. F.S., offered F 1999 & S 2000. *Prereq:* 330, 331 or 332. Advanced study of a selected topic in Hispanic literature and literary criticism. Nonmajor graduate credit.

Span 490. Independent Study. Cr. 1 to 6 each time taken. *Prereq:* 6 credits in Spanish and permission of department chair. No more than 9 credits in Span 490 may be counted toward graduation. Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields.

Span 493. Cultural Workshop for Second-Language Teachers (Spanish). (1-3) Cr. 1 to 3. SS. *Prereq:* Experience in teaching Spanish. Review of special language problems within the context of Hispanic cultures. May be repeated for a maximum of 9 credits. Nonmajor graduate credit.

Span 494. Hispanic Dialectology. (Same as Ling 494.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 301 or 350 recommended; *Engl 219 or Span 497.* Intensive study of the phonology, morphosyntax and lexicon of the Hispanic dialects and variants of Spain and Latin America in their historical context. Nonmajor graduate credit.

Span 495. Introduction to Spanish Phonology. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* Any one of the following courses: *Span 301, 303, 307 or 350; recommended: Engl 219 or Span 497.* An introductory study of the articulation, classification, distribution, and regional variations of the sounds of the Spanish language. Nonmajor graduate credit.

Span 496. Contrastive Analysis of Spanish/English Syntax. (Same as Ling 496.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 301 or 350; *Engl 219, Span 497 recommended.* Linguistic study of the major differences between the Spanish and English grammatical systems, with emphasis on those areas of contrast useful to teachers of Spanish. Nonmajor graduate credit.

Span 497. Spanish Linguistics. (Same as Ling 497.) (3-0) Cr. 3. F. *Prereq:* Credit or enrollment in 301; *Ling 219 recommended.* An introduction to Spanish linguistics and its applications in teaching Spanish. Phonology, morphology, syntax, and lexicon of Spanish. Theories of foreign language teaching and learning. Nonmajor graduate credit.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Span 580. Graduate Seminar in Hispanic Literature or Culture. Cr. 1 to 3. F.S.SS. *Prereq:* 6 cr. of 400 level Spanish. Topics may include a particular period, a genre, an author, a theme, or a particular type of cultural production, according to the interests of students and faculty. May be taken for 1-3 credits each time for up to 9 credits. Nonmajor graduate credit.

Span 590. Special Topics in Spanish. Cr. 1 to 4 each time taken. *Prereq:* Permission of instructor; 6 credits of 400 level Spanish.

- A. Literature or Literary Criticism
- B. Linguistics
- C. Language Pedagogy
- D. Civilization

Special Courses in Foreign Languages (F Lng)

F Lng 486. Methods in Elementary School Foreign Language Instruction. (Same as C I 486 and Ling 486.) (3-0) Cr. 3. S. *Prereq:* 25 credits in a foreign language. Current educational methods and their application in the elementary school classroom. Special

emphasis on planning, evaluation, and teaching strategies.

F Lng 487. Methods in Secondary School Foreign Language Instruction. (Same as Ling 487 and C I 487.) (6-0) Cr. 3. S. *Prereq:* 25 credits in a foreign language. Current educational methods and their applications to the classroom. Special emphasis on planning, objectives, and teaching techniques. Actual practice in some of the techniques.

F Lng 492. History of the Romance Languages. (Same as Ling 492.) (3-0) Cr. 3. S. *Prereq:* Reading knowledge of Latin or a modern Romance language. From pre-classical Latin to the modern Romance languages, emphasizing both internal history (changes in sounds and forms) and external history (the social, political, and geographic context in which the language is spoken). Methods of historical linguistics. Readings in earliest texts. Nonmajor graduate credit.

F Lng 498. History of the Germanic Language. (Same as Ling 498.) (3-0) Cr. 3. S. *Prereq:* Reading knowledge of German. Early philological history of German as it separates from Indo-European, development through the Old High and Middle High German periods, including the earliest written evidence. Influence of Martin Luther on modern German; theory of the development of Yiddish; modern sociolinguistic treatment of German outside of Germany, particularly in the United States, e.g., in the Amish Colonies as well as among the Old Order Amish. Nonmajor graduate credit.

Forestry

www.forestry.iastate.edu

James M. Kelly, Chair of Department

University Professors: McNabb

University Professors (Emeritus): Hinz

Professors: Countryman, Hall, Harrington, Hart, Jungst, Kelly, Schultz, Wray

Distinguished Professors (Emeritus): Scholtes

Professors (Emeritus): Benseid, Hopkins, Manwiller, Prestemon

Associate Professors: Colletti, Kuo, Mize, Rufe

Associate Professors (Adjunct): Stokke

Assistant Professors: Thompson

Assistant Professors (Adjunct): Negreros-Castillo

Undergraduate Study

The Department of Forestry offers courses that are concerned with the management of forest ecosystems for multiple benefits including wood and fiber products, biodiversity, recreation, water, wilderness, and wildlife.

The department offers work for the bachelor of science degree with a major in forestry and options in forest ecosystem management, urban and community forestry, or wood products. The education options in forest ecosystem management and wood products leading to a professional degree in forestry (Bachelor of Science) have been accredited by the Society of American Foresters (SAF) since 1935. The SAF is a specialized accrediting body recognized by the Council on Post Secondary Accreditation and the U.S. Department of Education as the accrediting body for forestry in the United States. The primary goal of the undergraduate curriculum in

forestry is to educate foresters to be capable of scientifically managing the nation's forest lands. The purpose of the undergraduate curriculum in forestry is to prepare students for professional employment in management and utilization of natural resources and to equip them to function effectively in a complex society.

Graduates understand and can apply scientific principles associated with forests, forest ecosystem management, and wood and non-wood products. Graduates are able to communicate effectively and work well in teams. They are capable of preparing and delivering effective oral and written communication of scientific and technical decisions to professional and lay audiences. They are proficient in technical skills such as measurements, computers, inventory, economic analysis, data and situation analysis, and ecosystem assessment. They recognize the importance of ethics in forestry and are sensitive to cultural diversity and broad environment concerns.

Graduates of the forest ecosystem management option are skilled at understanding how forests function and how forests can be managed to produce desired goods (wood, fiber, recreation, wildlife habitat) and services (clean water, carbon sequestration, wilderness) in the long-run. They are skilled at interpretation of interactions and effects of abiotic and biotic factors in forests and quantification of biophysical, social, and economic outputs from forest ecosystems. They are skilled at complex decision-making involving private and public forest resources where ethical, legal, social, economic, and ecological dimensions are explicitly considered.

Graduates of the urban and community forestry option are able to combine biological, social, legal, and economic expertise to effectively manage trees or forests in an urban setting. They are skilled at decision-making related to site assessment, and long-term management of urban trees and forests to achieve multiple goals.

Graduates of the forest products option understand the anatomical, physical, and chemical properties of wood and know wood processing operations involved in drying, machining, gluing, and chemical treatment of wood. They are skilled at applying their knowledge in the development of products and processes. They are able to provide scientific and technical problem-solving and marketing decisions for customers of wood products.

Elective courses related to the forest ecosystem management option can be selected to emphasize forest ecology; wildlife, wilderness, and recreation management; water quality and erosion protection; quantitative-analytical techniques; business and marketing; and other areas related to natural resource management. Elective courses in the urban and community forestry option can be selected to emphasize plant health, policy and planning, ecology, hydrology, sociology, business administration, or horticulture/design. Similarly, elective courses in the wood products option can be selected to emphasize wood production, wood fiber, business and marketing, and quality assurance.

Many private firms as well as national, regional, state, and local agencies seek forestry graduates to fill positions in management of natural resources for commodity and non-commodity multiple benefits. Graduates in forestry are prepared to be involved with evolving forestry systems, such as agroforestry and urban forestry. Wood processing industries, such as composite products, plywood, particle board, lumber, and pulp and paper offer professional opportunities in production, product development, quality control, and marketing.

With advanced graduate study, the range of professional job opportunities for a person with a B.S. in forestry is expanded. Opportunities include research and education as well as more specialized managerial and administrative positions with private firms and public agencies.

During fall semester of the second year of study (sophomore year, typically), forestry students are required to enroll in the department's integrated forestry modules consisting of 201, 202, 203, 204, 205, and 206. That semester, consisting entirely of forestry coursework, is designed to give students an early understanding of the many aspects of forestry and how they are interrelated. In addition to work in the classroom, students will spend time in laboratory and field work each week. A 3-week fall camp during the semester will reinforce concepts learned both in the classroom and during laboratory/field sessions. Transfer students should check with the department for counsel on timing their completion of the integrated forestry modules.

The department participates in interdisciplinary programs in environmental studies, pest management, plant health and protection, and international studies (see *Index*). By proper selection of elective courses, forestry students can obtain a second major in these programs or in other disciplines.

The department offers a minor in forestry which can be earned by completion of a minimum of 15 credits in forestry courses. Students wishing to emphasize management and environmental aspects of forestry must select at least 15 credits from the following courses: 120, 301, 302, 310, 345, 390, 407, 445. Students wishing to emphasize forest products and wood utilization must complete 280 and an additional 12 credits from the following courses: 281, 481, 483, 485, 486, 487.

Visit our departmental website at www.forestry.iastate.edu

Contact us at: e-mail; forestry@iastate.edu.

Graduate Study

The department offers programs leading to the degrees of master of science and doctor of philosophy with a major in forestry and minor work to students taking major work in other departments. Areas of specialization for the M.S. degree are forest administration and management, forest biology, forest biometry, forest economics and marketing, and wood science. Areas of specialization for the Ph.D.

are forest biology-wood science, forest biometry, and forest economics.

Graduates are skilled at defining a research problem in forestry, applying scientific principles and appropriate methods, and analyzing the results. They are capable of understanding the many facets of forest and wood science and are very knowledgeable in specific areas in forestry. They are able to deal with complex forestry problems, and where appropriate, they are capable of blending ecological, social, ethical, legal, and economic factors in the research process. They are very skilled at communicating, both in written and oral form, research results to professional and lay audiences. They are sensitive to cultural diversity and work effectively with peers, natural resource professionals, and the public.

The graduate program is open to and suitable for students who have majored in forestry or related natural resource fields. A non-thesis master's option is available. All students are required to teach and conduct research as part of their training for the Ph.D. degree.

The department participates in the Masters in Business Administration (M.B.A.), with specialization in the agriculture program administered by the College of Business, providing an opportunity to obtain an M.B.A. degree while taking advanced courses in forestry and maintaining contact with the profession of forestry. The department also participates in interdepartmental majors in ecology and evolutionary biology, plant physiology, genetics, and water resources (see *Index*).

Courses open for nonmajor graduate credit: 301, 302, 342, 345, 390, 402, 407, 416, 451, 452, 453, 454, 481, 483, 485, 486, 487.

Courses Primarily for Undergraduate Students

For 104. Practical Work. Cr. R. Practical work experience in forestry. See adviser for departmental requirements.

For 110. Orientation in Forestry. (1-0) Cr. R. F. Orientation to the University and to the Department of Forestry. Career opportunities.

For 120. Introduction to Renewable Resources. (Same as Agron 120, AST 120, A Ecl 120, Env S 120.) (3-0) Cr. 3. F.S. Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

For 201. Forest Biology. (2-0) Cr. 2. F. *Prereq:* Concurrent enrollment in 202, 203, 204, 205, and 206. Discussion of ecological concepts, individual tree structure and growth, variation and diversity in tree populations. Physical environment of trees and forests, ecological processes in forest communities, and introduction to different regional forest communities.

For 202. Harvesting/Wood Utilization. (2-0) Cr. 2. F. *Prereq:* Concurrent enrollment in 201, 203, 204, 205, and 206. Modern harvesting principles and practices. Best management practices (BMPs) for controlling soil erosion associated with harvesting. Wood as a material, processing of wood and wood fiber into products, end-uses of wood products, and technological changes in processing and end-use.

For 203. Resource Measurements/Evaluation. (2-0) Cr. 2. F. *Prereq:* Concurrent enrollment in 201, 202, 204, 205, and 206; *Math 140*. Survey techniques involved in quantification, valuation, and evaluation of tree and stand growth and other variables in the forest environment (e.g., recreational use, water quantity and quality, wildlife habitat value, biomass, and

solid wood). Use of Global Positioning Systems (GPS) for site location and navigation.

For 204. Forest Ecosystem Decision-Making. (2-0) Cr. 2. F. *Prereq:* Concurrent enrollment in 201, 202, 203, 205, and 206. Methods of decision-making related to forest ecosystems including communications, teams and conflict resolution. Current issues relating to public, private, and urban forests; quantification of processes, services, and goods produced by the forest and expected by the public such as wildlife, water, range, recreation, wilderness, biodiversity, as well as wood and fiber products.

For 205. Integrated Forestry Laboratory. (0-8) Cr. 3. F. *Prereq:* Concurrent enrollment in 201, 202, 203, 204, and 206. Field and laboratory exercises integrating the evaluation and management of forest goods, services, and the processing of wood products. Field trip fee.

For 206. Fall Forestry Camp. Cr. 4. F. *Prereq:* Concurrent enrollment in 201, 202, 203, 204, and 205. Three-week field camp to address topics and issues covered in 201, 202, 203, 204, and 205. Field trip fee.

For 280. Wood Anatomy and Properties. (3-0) Cr. 3. S. Consideration of the anatomy and properties of wood and how they relate to its successful use.

For 281. Wood Identification. (0-3) Cr. 1. S. Comparative anatomical characteristics and hand lens identification of commercially important North American woods.

For 283. Pesticide Application Certification. (Same as Ent 283.) See *Entomology*.

For 301. Forest Ecology. (Same as EnSci 301, PI HP 301.) (3-3) Cr. 4. F. *Prereq:* *Biol 201, 201L; For 201 or a second course in biology*. Effects of genetic, physiological, soil, and environmental factors on forest ecosystem dynamics. Emphasis on human influence on the forest ecosystem. Field trip fee. Nonmajor graduate credit.

For 302. Silviculture. (2-3) Cr. 3. S. *Prereq:* 201. Manipulation of forest vegetation based on ecological principles for the production of goods and services. Nonmajor graduate credit.

For 310. Management of Small Forest Properties. (3-0) Cr. 2. S. Techniques of forest management with emphasis on small private holdings. Non-forestry majors only. Course terminates at the end of 11 weeks.

For 342. Dynamics of Forest Stands. (2-3) Cr. 3. F. *Prereq:* 203, *Stat 101*. Examination of factors affecting individual tree and forest growth. Estimation of growth and yield of even-aged and all-aged stands. Examination of ways to assess site quality and competition. Review of simple random sampling and introduction to stratified random sampling and other sampling techniques. Nonmajor graduate credit.

For 345. Natural Resource Photogrammetry and Photo-Interpretation. (2-3) Cr. 2 to 3. F. *Prereq:* *Junior classification. Nonmajors should enroll for 2 credits, majors should enroll for 3 credits*. Use of aerial photos and remotely sensed imagery in resource management. Training in techniques of photo measurement, interpretation, and use of Geographic Information Systems (GIS). Principles of remote sensing. 2-credit course terminates at end of 11 weeks. Materials fee. Nonmajor graduate credit.

For 356. Dendrology. (Same as Bot 356.) See *Botany*.

For 390. Forest Fire Protection and Management. (3-0) Cr. 3. F. Characteristics and role of fire in forest ecosystems. Major topics covered include fuels, fire weather, fire behavior, fire danger rating systems, fire control, and prescribed burning. Nonmajor graduate credit.

For 402. Environmental Analysis of Watersheds: Hydrology and Surficial Processes. (Same as Agron 402, EnSci 402, Geol 402.) (3-2) Cr. 4. F. *Prereq:* Four courses in physical or biological sciences or engineering. Hydrobiogeomorphic approach to the transport of water and materials in watersheds. Laboratory emphasizes field investigation of

watershed-scale processes. Nonmajor graduate credit.

For 407. Watershed Management. (Same as Env S 407.) (3-3) Cr. 4. S. *Prereq:* *A course in general biology.* Managing human impacts on the hydrologic cycle. Field and watershed landscape best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers. Field trip fee. Nonmajor graduate credit.

For 416. Forest Pest Management. (Same as PI P 416.) See *Plant Pathology*. Nonmajor graduate credit.

For 451. Forest Resource Economics and Quantitative Methods. (3-3) Cr. 4. S. *Prereq:* 203, *Econ 101, Math 150.* Application of economic principles to forest resource management. Methods of identifying and specifying problems in the management and use of forest resources. Application of mathematical and statistical models to the solution of managerial problems. Nonmajor graduate credit.

For 452. Forest Ecosystem Management. (2-3) Cr. 3. F. *Prereq:* 451. Principles of planning, regulating, and decision-making associated with public and private forests. Optimization of multiple-goal forestry with resource and policy constraints. Integrated forest resources management and evaluation of ecosystem management models. Nonmajor graduate credit.

For 453. Forest Resource Policy and Administration. (3-0) Cr. 2. S. *Prereq:* 451. Contemporary forest resource policies and issues. Processes involved in the formulation of public and private policy. Legal opportunities and restraints. Conflict resolution. Historical development of forest resource policy. Course terminates at end of 11 weeks. Nonmajor graduate credit.

For 454. Forest Resource Case Studies. (1-4) Cr. 3. S. *Prereq:* 20 credits in student's major at 300 level or above. Integrated case studies of forest resources management and utilization to illustrate methods of integrating economic, ecological, social, political, and administrative principles discussed in preceding courses. Emphasis on decision-making. Field trips and discussion sessions arranged. Nonmajor graduate credit.

For 455. Forest Planning and Administration. (3-0) Cr. 1. S. *Prereq:* 451. Personnel management styles and organizational structure as applied to forestry. Planning processes in forestry, particularly in relation to public forests. Use of PERT and CPM in project administration, the communication environment, problems in organization and methods of conflict resolution. Ethics in forestry. Course terminates at the end of 5 weeks.

For 460. Agroforestry Systems. (Dual-listed with 560; same as Agron 460.) (2-3) Cr. 3. Alt. F., offered 2000. *Prereq:* 6 credits in biological science at 300 level or above. Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry. Field trip fee.

For 475. Community Tree Management. (Same as Hort 475, PI HP 475.) (2-3) Cr. 3. F. *Prereq:* *Junior or senior classification, 3 credits in biology.* Discussion of establishment and management of woody perennials in community-owned urban greenspaces, consideration of urban site and soil characteristics, plant physiology, plant culture, urban forest valuation, inventory methods, species selection, urban forest maintenance (health care and pest management), urban forest administration, legal and political issues, and landscape ecology (including wildlife) of the urban forest. Field trip fee.

For 476. Urban Forest Resource Planning and Policy. (2-0) Cr. 2. S. *Prereq:* *Senior classification, For 475.* Analysis of natural resource administration, policy, and planning in an urban context. Legal and political issues and policies influencing natural resource use decisions in densely populated areas. Nonmajor graduate credit.

For 481. Chemical Conversion of Wood. (2-3) Cr. 3. Alt. S., offered 2001. *Prereq:* 280. Chemical properties of wood. Pulp and paper technology. Other fiber products. Cellulose derivatives. Nonmajor graduate credit.

For 483. Wood Deterioration and Preservation. (Same as Ent 483, PI P 483.) (2-3) Cr. 3. Alt. F., offered 1999. *Prereq:* 280. Deterioration by biological and physical agents of wood in use. Wood preservation and fire retardant treatments. Nonmajor graduate credit.

For 485. Adhesive Bonded Wood Products. (3-3) Cr. 4. Alt. F., offered 2000. *Prereq:* 280. Production of laminated wood, plywood, wafer boards, particleboard, and medium density fiberboard; includes wood variables, adhesives, processes, use of wood residues, and combining wood with other materials. Nonmajor graduate credit.

For 486. Wood Drying. (2-3) Cr. 3. Alt. S., offered 2000. *Prereq:* 280. Movement of liquids and gases in wood. Seasoning techniques; shrinkage and swelling of wood. Nonmajor graduate credit.

For 487. Physical Properties of Wood. (3-3) Cr. 4. Alt. S., offered 2000. *Prereq:* 280. Mechanical, thermal, electrical, and acoustical properties of wood; lumber grading and stress rating. Nonmajor graduate credit.

For 490. Independent Study. Cr. 1 to 4 each time elected. *Prereq:* *Junior classification, permission of instructor.* A maximum of 6 credits of 490 may be used toward the total of 128 credits required for graduation.

- A. Forest Biology
- B. Forest Biometry
- C. Forest and Recreation Economics
- D. Forest Management
- E. Wood Science
- G. Forest Photogrammetry
- H. Honors Program
- I. Forest Recreation Resource Management

For 498. Cooperative Education. Cr. R. *Prereq:* *Permission of departmental chair.* Required of all cooperative education students. Students must register prior to commencing each work period.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

For 501. Forest Tree Improvement and Genetics. (2-3) Cr. 3. Alt. F., offered 1999. *Prereq:* *Gen 320 or Biol 301.* Genetic principles as they apply to selection and breeding of forest trees. Variation and genetic systems in trees, selection techniques, polyploidy, floral biology, cloning, hybridization techniques, and operational tree improvement programs.

For 504. Advanced Forest Ecology and Silviculture. (3-3) Cr. 4. Alt. F., offered 2000. *Prereq:* 301. Detailed analysis of factors and processes underlying forest and stand growth and development. Applications of this knowledge to forest culture to support a diversity of use and protection objectives. Discussions of regional silviculture, tropical forests, and experimentation in forest biology. Field trip fee.

For 510. Methods for Presenting Scientific Results. (1-0) Cr. 1 each time taken. S. *Prereq:* *Permission of instructor.* Techniques of proper platform presentation. Discussion of effective audio/visual techniques for presentation of research findings. Practice in development of overheads and slides. Use of computer generated and projected visuals. Practice in oral presentation with critical review.

For 543. Forest Biometry. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* *Stat 401, permission of instructor.* Development of volume and taper functions. Examination of measures of site quality and density and growth models. Application of sampling methods to forest research surveys.

For 550. Advanced Quantitative Methods in Forestry. (2-3) Cr. 3. Alt. S., offered 2000. *Prereq:* *One course in quantitative analysis or systems analysis.* Advanced quantitative methods as applied to forestry management problems. Linear program

ming, dynamic programming, PERT/CPM, simulation, and other modeling techniques.

For 560. Agroforestry Systems. (Dual-listed with 460; same as Agron 560.) (2-3) Cr. 3. Alt. F., offered 2000. *Prereq:* 6 credits in biological science at 300 level or above. Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry. Field trip fee.

For 570. Resource Allocation in Forestry. (2-2) Cr. 3. Alt. S., offered 2001. *Prereq:* 451 or two courses in economics. Analytical approach to economic aspects of forest resource management problems. Theory and application of economic decision-making criteria to traditional and modern forest resource management issues. Current problems in the allocation of forest resources.

For 580. Sustainable Agriculture Seminar. (Same as An S 580.) See *Animal Science*.

For 587. Advanced Topics in Wood Science. (2-0) Cr. 2. Alt. F., offered 1999. *Prereq:* 280. Recent contributions of research and technology to product development. Areas of emphasis in basic and applied research.

For 590. Special Topics. Cr. 1 to 4 each time elected. *Prereq:* *Permission of instructor.*

- A. Forest Biology
- B. Forest Biometry
- C. Forest and Recreation Economics
- D. Forest Management
- E. Wood Science
- G. Forest Photogrammetry
- I. Forest Recreation Resource Management
- J. Wood Anatomy and Microtechniques
- K. Wood Chemistry
- L. Wood Physics
- M. Wood in Structures

For 594. Advanced Forest Resource Management. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 454. A seminar approach to the critical analysis of forest management problems as exemplified in public agencies and private firms.

For 599. Creative Component. Cr. 1 to 8.

- A. Forest Biology
- B. Forest Biometry
- C. Forest and Recreation Economics
- D. Forest Management and Administration
- E. Wood Science

Courses for Graduate Students

For 603. Tree Growth and Development. (4-0) Cr. 4. Alt. S., offered 2000. *Prereq:* 301 or a course in plant physiology. Structure and function of individual trees and shrubs. Emphasis is on factors that make woody plants different from herbaceous plants. Response of individuals to such environmental factors as radiation, temperature, water stress, flooding, and compaction, air pollution, fire and wind.

For 654. Advanced Topics in Forest Economics. (1-0) Cr. 1. May be taken twice for credit. Alt. S., offered 2001. *Prereq:* *Permission of instructor.* Discussion and presentation of advanced forest economic problems with particular attention to recent theories and applications. Emphasis on applications of micro and macroeconomic principles to forest resource allocation and long range planning.

For 696. Seminar in Plant Physiology and Molecular Biology. (Same as Bot 696.) See *Botany*.

For 699. Research. Cr. 1 to 8.

- A. Forest Biology—Wood Science
- B. Forest Biometry
- C. Forest Economics
- D. Forest Management and Administration
- E. Wood Science
- F. Plant Physiology

Genetics - Interdisciplinary

(Interdepartmental Graduate Major)

Supervisory Committee: S. R. Rodermel,
Chair; R. Hall, Assoc. Chair; L. Ambrosio,
P. Chitnis, E. Pollak, C. Tuggle.

Participating Faculty: L. Ambrosio,
A. G. Atherly, T. Baum, G. Beattie, P. Becraft,
P. J. Berger, B. Bonning, B. Bowen,
V. Brendel, C. R. Bronson, C. Brummer,
S. Carpenter, P. Chitnis, H. H. Chou,
J. Colbert, J. Davies, J. Dekkers, D. Dobbs,
R. Fernando, C. F. Ford, A. E. Freeman,
J. R. Girtton, X. Gu, R. B. Hall, L. Halverson,
D. J. Hannapel, T. Harrington,
E. R. Henderson, J. Holland, F. Janzen,
K. M. Johansen, E. S. Krafus, S. J. Lamont,
M. Lee, G. Lindberg, C. Link, J. E. Mayfield,
W. A. Miller, F. C. Minion, A. M. Myers,
G. Naylor, B. J. Nikolau,
M. Nilsen-Hamilton, D. Oliver, R. G. Palmer,
P. A. Peterson, T. Peterson, G. Phillips,
E. Pollak, J. Powell-Coffman, S. R. Rodermel,
M. F. Rothschild, P. S. Schnable, M. P. Scott,
R. C. Shoemaker, M. H. Spalding,
L. C. Stephens, W. L. Summers,
R. W. Thornburg, C. K. Tuggle, D. F. Voytas,
R. Wallace, J. F. Wendel, R. L. Willham,
R. P. Wise, E. Wurtele

Undergraduate Study

Undergraduates wishing to prepare for graduate study in Genetics should elect courses in basic biology, chemistry at least through organic chemistry, one year of college-level physics, mathematics at least through calculus, and at least one thorough course in basic transmission and molecular genetics. One year of upper level statistics and a year of biochemistry are strongly encouraged.

A bachelor of science degree in Genetics is offered by the Department of Zoology and Genetics.

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in Genetics in thirteen cooperating departments: Agronomy; Animal Science; Biochemistry, Biophysics and Molecular Biology; Botany; Entomology; Food Science and Human Nutrition; Forestry; Horticulture; Plant Pathology; Statistics; Microbiology; Veterinary Microbiology and Preventive Medicine; and Zoology and Genetics.

The diversity of faculty in the Interdepartmental Genetics major ensures a broad, well-balanced education from the best instructors, while offering flexibility in choice of research area. Genetics faculty have strengths in many areas, from fundamental studies at the molecular, cellular, organismal, and population levels, to research with immediate practical application. Ongoing research projects span all the major areas of theoretical and experimental genetics, including molecular studies of gene regulation, gene mapping, transposable ele-

ment studies, developmental genetics, quantitative and mathematical genetics, computational molecular biology, evolutionary genetics, and population genetics.

First-year students majoring in Genetics may enter the Interdepartmental Genetics major by either of two routes: by direct admission to the Interdepartmental Genetics major or by admission to a department participating in the major followed by formal admission to the major. Students admitted directly into the Interdepartmental Genetics major will take Genet 697 (graduate research rotation) in their first two semesters and, by the end of their second semester, enter a department by choosing a major professor from the participating faculty. Students first admitted by a department will do research rotations within that department only and choose a major professor from participating Interdepartmental Genetics faculty in that department.

All Ph.D. candidates take a core curriculum comprising one course each from the following four categories and attend seminars and workshops as described: Transmission Genetics (Gen 510), Molecular Genetics (Gen 511 or BBMB 502), Quantitative and Population Genetics (An S/Agron 561 or Stat 436 or Gen 560 or Gen 562), Biochemistry (BBMB 404 or BBMB 501). Students will make research presentations, attend genetics faculty seminars, and participate in four Workshops in Genetics (Genet 591) in the training period. First-year graduate students will also take Genet 692 (Seminar in the Conceptual Foundations of Genetics). M.S. students will take the above core courses and seminars but will participate in only two workshops in Genetics. Additional coursework may be selected to satisfy individual interests or departmental requirements. The foreign language requirement and teaching requirement are determined by the student's department.

The course designator *Genet* applies to graduate courses taught by the interdepartmental major in Genetics. The course designator *Gen* applies to courses taught by the Department of Zoology and Genetics (see separate listing).

Students minoring in Genetics at the Ph.D. level must meet the following requirements: Completion of three of the four categories of the common-core required lecture courses listed above. One semester of seminar in Genetics (Genet 690 or 691 or 692) is recommended. One member of the POS committee must be a Genetics faculty member.

Courses for Graduate Students

Genet 590. Special Topics. Cr. arr.

Genet 591. Workshop in Genetics. (1-0) Cr. 1 each time taken. S. *Prereq:* *Permission of instructor.* Current topics in genetics research. Lectures by off-campus experts. Students read background literature, attend preparatory seminars, attend all lectures, meet with lecturers.

Genet 690. Seminar in Genetics. (1-0) Cr. 1 each time taken. F. *Prereq:* *Permission of instructor.* Student research presentations.

Genet 691. Seminar in Genetics. (1-0) Cr. 1 each time taken. F. *Prereq:* *Permission of instructor.* Faculty research series.

Genet 692. Seminar in the Conceptual Foundations of Genetics. (1-0) Cr. 1. F. *Prereq:* *Permission of instructor.* Student and faculty presen-

tations of landmark papers in genetics. Brief history of ideas of the period included as background material.

Genet 697. Graduate Research Rotation. Cr. var. each time taken. F.S.SS. Graduate research projects performed under the supervision of selected faculty members in the Interdepartmental Genetics major.

Genet 699. Research.

Geological and Atmospheric Sciences

Paul G. Spry, Chair of Department

Distinguished Professors: Vondra

Professors: Chen, Jacobson, Seifert, Spry, Takle, Yarger

Professors (Collaborators): Branstator, Tribbia

Professors (Emeritus): Nordlie

Associate Professors: Cody, Deluca, Gutowski, Simpkins, Windom

Associate Professors (Adjunct): Kramer

Associate Professors (Collaborators): Burkart, Vallier

Assistant Professors: Beresnev, Gallus, Hoyle, Iverson

Assistant Professors (Adjunct): Kracher

Undergraduate Study

The department offers courses in Geology and Meteorology. Majors can be earned in earth science (B.A., B.S.), geology (B.S.), and meteorology (B.S.). Candidates for all degrees must satisfy the requirements established by the College of Liberal Arts and Sciences (see *Liberal Arts and Sciences, Curriculum*). In addition, the department has requirements for each major.

The bachelor of science in Geology prepares the student for a professional career and/or graduate study in the geological sciences. Required courses form the traditional core of the major, while electives allow the student to explore environmental and economic aspects of Geology. Required geology courses total 47 credits and include Geol 100, 100L, 102, 102L, 110, 302, 305, 311, 356, 365, 368, 480 and 9 credits in geology electives. Required supporting courses include Chem 177, 177L, 178, 178L and at least 4 additional credits in chemistry from an approved departmental list; Phys 221 and 222; Math 165, 166 or Math 181, 182; at least 6 additional credits of mathematics, statistics, or computer science from an approved departmental list. No more than 9 credits in 490 may be counted toward a degree in Geology.

The department offers a minor in Geology which may be earned by credit in Geol 100 and 100L (or 201), 102, 102L, plus 7 credits at the 300 level or above.

Graduates work to understand natural processes on Earth and other planets. They are able to apply their knowledge of forces

and factors that shape the Earth to reconstruct the past and anticipate the future. Graduates provide essential information for solving problems for resource management, environmental protection, and public health, safety, and welfare. They work as consultants on engineering and environmental problems, explorers for new minerals and hydrocarbon resources, researchers, teachers, writers, editors, and museum curators. Graduates are able to integrate field and laboratory data and to prepare reports. They are able to make presentations that include maps and diagrams that illustrate the results of their studies.

The study of Meteorology involves the description of the earth's atmosphere and the processes responsible for its behavior. Students majoring in Meteorology earn the bachelor of science. Successful preparation for professional or graduate work in Meteorology requires that the student develop and integrate a diverse range of skills and knowledge bases. These include weather observing, the physics and dynamics of the global atmosphere, application of new weather technologies, advanced mathematical tools, computer programming and modeling and effective oral and written communication. The faculty view the senior thesis (Meteorology 499), in particular, as a capstone experience in which students demonstrate they have achieved this integration. Also, contemporary meteorology is an earth-system science with ties to a variety of human experiences. The electives and general education requirements of the college are further experiences that the meteorology student must integrate with their core meteorology knowledge in order to function effectively in a global-oriented profession. The program normally includes the following courses: Mteor 101, 111, 206, 301, 311, 341, 342, 404, 411, 417, 432, 443, 454, 455, and 499. Supporting work is required in areas at least equivalent to Chem 163, 163L, 164; Phys 221, 222; Math 165, 166, 265, 266; Com S 207; Stat 105. A grade of C or better (not C-) is required in each of the following courses to meet minimum graduation requirements for a bachelor of science degree in Meteorology: 206, 301, 311, 341, 342, 411, 417, 432, 443, and 454.

Several co-op programs are available for upper division undergraduates. Although a range of opportunities exists for men and women who terminate their studies with a bachelor of science, students who meet the necessary academic standards are encouraged to continue their studies in a graduate program. For these students, minor work is recommended in a mathematical or physical science. Other students can choose a wide range of supporting courses that will contribute to their particular area of interest in meteorology.

The department offers a minor in Meteorology which may be earned by completing 15 credits including Mteor 111 (1 cr.), Mteor 206 and Mteor 301. Further information concerning programs of study, including sample degree programs, is available from the department.

The Earth Science major is a broad program that typically emphasizes an interdisciplinary field. Programs leading to the bachelor of sci-

ence may be individually designed but will include required courses in Geology and Meteorology, and required supporting work in chemistry, physics, and mathematics. Specific programs have been designed for students interested in a geology, meteorology, or an environmental earth science emphasis. Programs leading to the bachelor of arts for earth science teaching are available. The latter program must satisfy the requirements of the Teacher Education Program (see *Index, Teacher Education*).

English proficiency requirement: The department requires a grade of C or better in each of English 104 and 105 (or 105H), and a C or better in English 314 or 302 or JI MC 347.

Graduate Study

The department offers programs leading to the master of science and doctor of philosophy with majors in Earth Science, Geology, and Meteorology. Program options are available for the M.S. and Ph.D. degrees in earth science leading to careers in teaching. The department also cooperates in the interdepartmental major in Water Resources (see *Index*). Students desiring a major in the above fields normally will have a strong undergraduate background in the physical and mathematical sciences. Individuals desiring to enter a graduate program are evaluated by considering their undergraduate background and performance and their expressed goals.

Programs of study are designed on an individual basis in accordance with requirements of the Graduate College and established requirements for each departmental major. Minor work is normally taken in aerospace engineering, agronomy (soil science), chemistry, civil and construction engineering, computer engineering, computer science, engineering mechanics, materials engineering, mathematics, mechanical engineering, microbiology, physics, or statistics. Departmental requirements provide a strong, broad background in the major and allow considerable flexibility in the program of each individual.

A dissertation is required of all Ph.D. candidates. M.S. students in Geology are required to complete a thesis. The M.S. in Earth Science is available to students electing the non-thesis (Creative Component) option in Geology or Meteorology. A nonthesis option is also offered for the M.S. degree in Meteorology.

Graduates in Geology specialize in a subdiscipline, but they comprehend and can communicate the basic principles of geology and supporting sciences. They possess the capacity for critical and independent thinking. They are able to write a fundable research proposal, evaluate current relevant literature, carry out the proposed research, and communicate the results of their research to peers at national meetings and to the general public. They work as consultants on engineering and environmental problems, explorers for new minerals and hydrocarbon resources, researchers, teachers, writers, editors, and museum curators.

All candidates for an advanced degree in Meteorology are expected to complete Mteor 542, 543, and 555. In addition, students without prior synoptic course-work must complete Mteor 511; other students must complete Mteor 507 or Agron 507. Students must also complete Mteor 504 (or Agron 504) or Mteor 605 or Agron 505.

Graduates in Meteorology have a good comprehension of basic principles, a capacity for critical and independent thought and an ability to communicate effectively with scientific colleagues. They have an appropriate breadth in their understanding of meteorology with a suitable specialization. Graduates are able to undertake thorough research and explain the results in a scientifically reasonable fashion.

Courses open for nonmajor graduate credit: Geol 302, 305, 311, 356, 365, 368, 400, 401, 402, 411, 412, 422, 434, 474, 475, 480, 481, Mteor 301, 306, 311, 341, 342, 404, 406, 411, 417, 427, 432, 443, 454, and 455.

Geology (Geol)

Courses Primarily for Undergraduate Students

Geol 100. The Earth. (3-0) Cr. 3 or (3-1) Cr. 4. F.S.SS. DeLuca, Iverson, Seifert, Staff. What is the earth made of, and how does it work? Emphasis on observations and hypotheses used by geologists to determine the earth's structure and to understand how geologic features change with time. Students who enroll for the 4 credit option must register for a one hour discussion section. Students enrolling for either option may also enroll for Geol 100L.

Geol 100L. The Earth: Laboratory. (0-2) Cr. 1. F.S. *Prereq:* Credit or enrollment in 100. Characterization of rocks and minerals; interpretation of structures and landforms. Materials fee.

Geol 101. Environmental Geology: Earth in Crisis. (Same as Env S 101.) (3-0) Cr. 3 or (3-1) Cr. 4. F.S. Cody, Seifert. An introduction to geologic processes and the consequences of human activity from local to global scales. Discussion of human population growth, resource depletion, pollution and waste disposal, global warming and ozone depletion, desertification, and geologic hazards such as earthquakes, landslides, flooding, and volcanism. Students who enroll for the 4 credit option must register for a one hour discussion section.

Geol 102. History of the Earth. (3-0) Cr. 3. S. *Prereq:* 100 or 201. Vondra. The earth's physical and biological evolution: concepts of global tectonics. Methods used to decipher earth history. Students majoring in geology must also enroll in Geol 102L.

Geol 102L. History of the Earth: Laboratory. (0-2) Cr. 1. S. *Prereq:* Credit or enrollment in 102. Introduction to the use of sedimentary rocks and fossils in reconstructing the earth's history. Materials fee.

Geol 110. Orientation in Geology. (1-0) Cr. R. F. Staff. Orientation to the profession of Geology, the geology curriculum, and departmental activities. Open to first year Geology majors and transfer students only.

Geol 201. Geology for Engineers and Environmental Scientists. (2-3) Cr. 3. F.S. Windom. Introduction to Earth materials and processes with emphasis on engineering and environmental applications. Materials fee.

Geol 290. Independent Study. Cr. 2 to 4 each time taken. *Prereq:* Permission of instructor.

Geol 298. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Geol 100 or 201, 100L, 102, 102L, and permission of the department cooperative education coordinator: sophomore classification. Required of all cooperative education students. Students must register for this course prior to commencing the work period.

Geol 302. Summer Field Studies. Cr. 6 to 8. SS. *Prereq:* 102, 356, 365. Vondra. Aerial mapping: structural, stratigraphic, and geomorphologic analyses. Written reports with appropriate illustrations required. A 6-week summer field course required of all geology majors. Students who enroll for the 8 credit option must participate in a two week excursion to selected regions of the western U.S. Summer camp fee. Nonmajor graduate credit.

Geol 304I. Regional Geology of Northwest Iowa. (Same as la LL 304I.) See *Iowa Lakeside Laboratory*.

Geol 305. Computer Methods in Geology. (2-4) Cr. 3. F. *Prereq:* 100 or 201. Jacobson. Use of the microcomputer to solve graphical and computational problems in geology. Includes AutoCAD, spreadsheet, and graphical applications. Materials fee. Nonmajor graduate credit.

Geol 306. Geology Field Trip. Cr. 2 each time taken. F.S.SS. May be taken more than once. *Prereq:* 100 or 201, *permission of instructor*. Staff. Geology of selected regions studied by correlated readings followed by a field trip to points of geologic interest. Ten-day field trip required. Field trip fee.

Geol 311. Mineralogy and Crystallography. (3-6) Cr. 5. S. *Prereq:* 100 or 201, 305, *Chem 177*. Spry, Windom. Introduction to mineral classification, elementary crystallography, crystal morphology. Laboratory problems in crystallography and mineral identification methods, including hand-specimen identification, optical properties of minerals in immersion oils and thin sections, and x-ray diffraction techniques. Materials fee. Nonmajor graduate credit.

Geol 356. Structural Geology. (2-4) Cr. 4. S. *Prereq:* 100 or 201, 305; *Phys 111 or 221 (preferred)*, *Math 165*. Jacobson. Principles of stress and strain. Brittle and ductile behavior of rocks. Description and classification of joints, faults, folds, fractures, foliation, and lineation. Plate tectonics and regional geology. Laboratory includes application of geometrical techniques to solve structural problems; emphasizes map interpretation and use of stereonet and computer methods. Materials fee. Nonmajor graduate credit.

Geol 365. Petrology. (3-4) Cr. 5. F. *Prereq:* 311. Cody, Seifert. Nature and origin of igneous, metamorphic, and sedimentary rocks. Emphasis on important rock-forming environments and processes and their influence on rock characteristics. Laboratory includes thin section study of rock textures and mineralogy and the interpretation of these features. Field trips. Materials fee. Nonmajor graduate credit.

Geol 368. Stratigraphy and Sedimentation. (3-2) Cr. 4. F. *Prereq:* 365. Vondra. Origin of sedimentary rocks and the characteristics of major depositional systems, geologic time, stratigraphic nomenclature, methods of correlation, facies and facies analysis, sequence stratigraphy, sedimentary tectonics and basin analysis. Required field and laboratory-based problem with a comprehensive written report. Nonmajor graduate credit.

Geol 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Geol 100 or 201, 100L, 102, 102L, and permission of the department cooperative education coordinator; junior classification*. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Geol 400. Advanced Field Geology. Cr. 6 to 8. SS. *Prereq:* 302. Vondra. An 8-week field course for advanced geology majors emphasizing advanced field techniques and providing students with experience in analyzing geologic field problems. Summer camp fee. Nonmajor graduate credit.

Geol 401. Environmental Biogeochemistry. (Same as Bot 401, EnSci 401.) (3-2) Cr. 4. S. *Prereq:* *EnSci 330 or permission of instructor*. Hoyle and Raich. Biological, chemical, and physical phenomena controlling material, energy, and elemental fluxes in the environment. Nonmajor graduate credit.

Geol 402. Watershed Hydrology and Surficial Processes. (Same as Agron 402, EnSci 402, For 402.) (3-3) Cr. 4. F. *Prereq:* *Credit or enrollment in EnSci 330 or Geol 100 or 201, Phys 111, 3 credits in biology and 6 credits in chemistry*. Burras, Schultz, and Simpkins. Examination of watersheds as sys-

tems wherein biological and physical factors control hydrology, soil formation, and nutrient transport. Laboratory emphasizes field investigation of watershed-scale processes. Nonmajor graduate credit.

Geol 411. Hydrogeology. (Dual-listed with 511; same as EnSci 411.) (3-2) Cr. 4. F. *Prereq:* 100 or 201, *Math 165 or 181; Phys 111 or 221*. Simpkins. Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, and groundwater geochemistry. Introduction to groundwater flow modeling. Lab emphasizes applied field and laboratory methods for hydrogeological investigations. Field trip fee. Nonmajor graduate credit.

Geol 412. Paleontology. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 102. Cody. Interrelationships of biologic and geologic systems. Nature of the fossilization process; characteristics of fossils; uses of fossil remains in determining paleoecology, paleogeography, and broad trends in evolution. Materials fee. Nonmajor graduate credit.

Geol 422. Environmental Geochemistry. (Dual-listed with 522; same as EnSci 422.) (2-2) Cr. 3. F. *Prereq:* 402 or 411 or equivalent, *Chem 178 or equivalent background in chemistry*. Hoyle. Geochemistry of natural waters, including inorganic and organic constituents and water-rock interactions. Interpretation of water quality data. Geochemical equilibrium modeling and introduction to kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling. Materials fee. Nonmajor graduate credit.

Geol 434. Contaminant Hydrogeology. (Dual-listed with 534; same as EnSci 434.) (3-0) Cr. 3. S. *Prereq:* 411 and 422 or their equivalents. Hoyle. Brief review of organic and inorganic contaminants in industrial and agricultural settings. Process-oriented approach to abiotic and biological fate and transport of contaminants. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Groundwater remediation strategies. Nonmajor graduate credit.

Geol 474. Glacial and Quaternary Geology. (Dual-listed with 574.) (2-2) Cr. 3. Alt. S., offered 2001. *Prereq:* 100 or 201 or equivalent experience. Iverson, Simpkins. The study of the depositional and erosional processes of glaciers using modern glacier analogs and landforms. Discussion of glaciology, glacier hydrology, Quaternary history and stratigraphy, paleoclimatology, and causes of glaciation. Laboratory emphasizes aerial photo and topographic map interpretation and the Quaternary stratigraphy of Iowa. Two required field trips. Field trip fee. Nonmajor graduate credit.

Geol 475. Surficial Processes. (Dual-listed with 575, same as EnSci 475.) (2-2) Cr. 3. F. *Prereq:* 100 or 201 or equivalent experience. Iverson. Study of surficial processes in modern and ancient geological environments. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory emphasizes aerial photo and topographic map interpretation. Field trip fee. Nonmajor graduate credit.

Geol 480. Global Geology. (3-0) Cr. 3. S. *Prereq:* 302, 356, 368. Vondra. Lectures and seminars concerning the geologic architecture and evolutionary development of selected regions of continents and ocean basins. Written reports and oral presentations required. Nonmajor graduate credit.

Geol 481. Earth Resources and the Environment. (2-2) Cr. 3. Alt. F., offered 2000. *Prereq:* 365. Spry. Review of major processes which concentrate economically important materials in the earth. Nature and origin of metallic and non-metallic ore deposits, petroleum, and coal. Environmental effects of the production and use of mineral resources, including discussions of acid-mine drainage. Laboratory emphasizes the study of economic minerals from metallic deposits. Materials fee. Nonmajor graduate credit.

Geol 490. Independent Study. Cr. 2 to 4 each time taken. *Prereq:* 6 credits in geology and permission of

instructor. No more than 9 credits of Geol 490 may be counted toward graduation.

Geol 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Geol 100 or 201, 100L, 102, 102L, and permission of the department cooperative education coordinator; senior classification*. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Geol 505. Geology of Mineral Resources. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* *Geol 365*. Spry. Survey of the occurrence and the origin of major ore deposits and mineral resources and the effects of mining on the environment.

Geol 506. Geology Field Trip. Cr. 2 each time taken. May be taken more than once. F.S. *Prereq:* *Graduate classification*. Staff. Geology of selected regions studied by correlated readings, followed by a field trip to points of geologic interest. Ten-day field trip. Required of all students in graduate degree programs. Field trip fee.

Geol 507. Mineral Resources Field Trip. Cr. 1. F. *Prereq:* *Geol 365*. On-site inspection of various coal and ore deposits, mining operations, and mineral processing plants. Offered on a satisfactory-fail grading basis only.

Geol 510. Field Methods in Hydrogeology. (0-4) Cr. 2. Alt. SS., offered 2001. Simpkins. *Prereq:* 411 or 511 or C E 573. Introduction to field methods used in groundwater investigations. In-field implementation of pumping tests, slug tests, monitoring well installation and drilling techniques, geochemical and water quality sampling, seepage meters, minipiezometers, stream gaging, electronic instrumentation for data collection, and geophysics. Local field trips to examine sites undergoing remedial investigation. Karst hydrology field trip to the Big Spring Basin in Northeast Iowa. Field trips, materials fee.

Geol 511. Hydrogeology. (Dual-listed with 411.) (3-2) Cr. 4. F. *Prereq:* 100 or 201, *Math 165 or 181; Phys 111 or 221*. Simpkins. Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, and groundwater geochemistry. Introduction to groundwater flow modeling. Lab emphasizes applied field and laboratory methods for hydrogeological investigations. Field trip fee.

Geol 522. Environmental Geochemistry. (Dual-listed with 422.) (2-2) Cr. 3. F. *Prereq:* 511 or equivalent, *Chem 178 or equivalent background in chemistry*. Hoyle. Geochemistry of natural waters, including inorganic and organic constituents and water-rock interactions. Interpretation of water quality data. Geochemical equilibrium modeling and introduction to kinetics. Laboratory emphasizes chemical analysis of waters and computer modeling. Materials fee.

Geol 532. Geochemistry. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 541; *physical chemistry recommended*. Windom. Thermodynamic and kinetic methods for interpreting geochemical processes and environments. Emphasis on processes of interest to petrologists: phase relations in binary systems, kinetics of crystallization, isotopic systematics, hydrothermal systems, planetary evolution. Computer modeling.

Geol 534. Contaminant Hydrogeology. (Dual-listed with 434.) (3-0) Cr. 3. S. *Prereq:* 511 and 522 or their equivalents. Hoyle. Brief review of organic and inorganic contaminants in industrial and agricultural settings. Geochemical interactions with porous media. Process-oriented approach to abiotic and biological fate and transport of contaminants. Investigation of coupled processes (diffusion, advection, dispersion, sorption, and biodegradation) using computer models. Groundwater remediation strategies.

Geol 541. Mineral Chemistry and Physics. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 317. Windom. Fundamentals of crystal chemistry and application to common rock-forming minerals, especially silicates. Chemical bonding, polyhedral packing, thermody

dynamic modeling of mineral behavior, mineral genesis, and metamorphism.

Geol 542. Optical Mineralogy. (1-2) Cr. 2. S. *Prereq:* 311. Spry. Introduction to using the microscope for mineral identification. Optical properties of minerals in immersion oils and in thin section. Research project required. Materials fee.

Geol 543. Microanalysis of Geologic Materials. (1-3) Cr. 2. F. *Prereq:* 541 and permission of instructor. Staff. Theory and operation of the electron microprobe with emphasis on the analysis of geologic materials. Sample preparation, data acquisition and data correction schemes utilizing both energy dispersive and wavelength dispersive x-ray detection systems. Class size strictly limited to 12.

Geol 550. Advanced Structural Geology. (2-2) Cr. 3. Alt. S., offered 2000. *Prereq:* 356. Jacobson. Principles of stress and strain; folding, faulting, development of schistosity and lineation; deformation mechanisms and flow laws; development and tectonic implications of crystallographic preferred orientations. Lab includes descriptive geometry, use of the stereonet, and computer applications. Materials fee.

Geol 553. Computer Mapping. (2-4) Cr. 4. Alt. F., offered 1999. *Prereq:* Geol 305. Jacobson. Preparation of digital geologic maps, contour maps, and related drawings using AutoCAD and GIS software. Includes the techniques for plotting and analyzing spatial data associated with maps. Materials fee. Nonmajor graduate credit.

Geol 555. Soil Clay Mineralogy. (Same as Agron 555.) See *Agronomy*.

Geol 555L. Soil Clay Mineralogy Laboratory. (Same as Agron 555L.) See *Agronomy*.

Geol 562. Igneous Petrology. (2-2) Cr. 3. Alt. S., offered 2000. *Prereq:* 532. Seifert, Windom. Consideration of physical and chemical evidence of the origin and evolution of igneous rocks; nature of crustal and mantle course regions; physical properties of magmas, behavior of major and minor trace elements during melting and crystallization processes. Emphasis will be placed on modern theories of magmatic processes. Laboratory involves microscopic examination of igneous rocks in thin section, computer applications. Materials fee.

Geol 564. Metamorphic Petrology. (2-2) Cr. 3. Alt. S., offered 2001. *Prereq:* 532. Jacobson. Mineral assemblages and textures of contact, dynamic, and regionally metamorphosed rocks; processes of recrystallization and deformation as functions of environmental conditions; regional patterns of metamorphic belts. Laboratory involves microscopic examination of metamorphic rocks in thin section, computer applications. Materials fee.

Geol 571. Principles of Stratigraphy. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 412. Vondra. Basic concepts in stratigraphy, stratigraphic subdivision and nomenclature, correlation, facies and facies analysis, sedimentary tectonics, and basin analysis.

Geol 574. Glacial and Quaternary Geology. (Dual-listed with 474.) (2-2) Cr. 3. Alt. S., offered 2001. *Prereq:* 100 or 201. Iverson, Simpkins. The study of the depositional and erosional processes of glaciers using modern glacier analogs and landforms. Discussion of glaciology, glacier hydrology, Quaternary history and stratigraphy, paleoclimatology, and causes of glaciation. Laboratory emphasizes aerial photo and topographic map interpretation and the Quaternary stratigraphy of Iowa. Two required field trips. Field trip fee.

Geol 575. Surficial Processes. (Dual-listed with 475.) (2-2) Cr. 3. F. *Prereq:* 100 or 201 or equivalent experience. Study of surficial processes in modern and ancient geological environments. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory emphasizes aerial photo and topographic map interpretation. Field trip fee.

Geol 576. Clastic Sedimentation. (2-2) Cr. 3. Alt. S., offered 2000. *Prereq:* 571. Vondra. Interpretation of

clastic sedimentary rocks to infer processes, environments, and tectonic settings under which they formed. Major clastic facies of selected regions studied and analyzed. Field trips. Materials fee.

Geol 578. Chemical Sedimentation. (2-2) Cr. 3. Alt. S., offered 2001. *Prereq:* 365, 571. Cody. Survey of the origin and characteristics of recent and ancient chemical sediments: clays, carbonates, phosphates, zeolites, and sulfates. Materials fee.

Geol 582. Economic Geology. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 365. Spry. Major processes which concentrate economically important materials in the earth, particularly the nature and origin of metallic ore deposits. Geochemical conditions of ore formation using stable isotopes, fluid inclusions, and sulfide stability studies. Laboratory emphasizes the study of economic minerals from metallic deposits. Materials fee.

Geol 590. Special Topics. Cr. 1 to 3 each time taken. *Prereq:* Permission of instructor

- A. Surficial Processes
- B. Stratigraphy
- C. Sedimentation
- D. Paleontology
- E. Petrology
- F. Structural Geology
- G. Geochemistry
- H. Hydrogeology
- I. Earth Science
- J. Mineral Resources
- K. Geophysics
- L. Mineralogy
- M. Tectonics

Geol 595. Seminar. Cr. R. F.S. *Prereq:* Senior or graduate classification. Weekly seminar on topics of current research interest. All students seeking a graduate degree in geology must enroll during each semester of residence. Students pursuing a non-thesis option for the M.S. in Earth Science must enroll for one semester.

Geol 599. Creative Component. Cr. var.

Courses for Graduate Students

Geol 610. Seminar in Hydrogeology. Cr. 2 to 4 each time taken. F.S. *Prereq:* 510, 511, 522 or 534; C E 579.

Geol 640. Seminar in Earth Materials. Cr. 2 to 4 each time taken. F.S. *Prereq:* 532, 541, or 564.

Geol 650. Seminar in Geotectonics. Cr. 2 to 4 each time taken. F.S. *Prereq:* 550.

Geol 660. Seminar in Sedimentation and Stratigraphy. Cr. 2 to 4 each time taken. F.S. *Prereq:* 571 or 578.

Geol 670. Seminar in Surficial Geology. Cr. 2 to 4 each time taken. F.S. *Prereq:* 575 or 574.

Geol 680. Seminar in Economic Geology. Cr. 2 to 4 each time taken. F.S. *Prereq:* 582.

Geol 699. Research. Cr. var.

- A. Surficial Processes
- B. Stratigraphy
- C. Sedimentation
- D. Paleontology
- E. Petrology
- F. Structural Geology
- G. Geochemistry
- H. Hydrogeology
- I. Earth Science
- J. Mineral Resources
- K. Geophysics
- L. Mineralogy
- M. Tectonics

Meteorology (Mteor) Courses Primarily for Undergraduate Students

Mteor 101. Introductory Seminar. (1-0) Cr. R. F. An overview of the atmospheric sciences, the meteorology program, weather forecasting, and general university procedures.

Mteor 111. Synoptic Applications. (1-0) Cr. 1 each time taken, maximum of 3. F.S. Current weather dis

ussions and introduction to synoptic-scale interpretation of meteorology.

Mteor 206. Introduction to Meteorology. (Same as Agron 206.) (3-0) Cr. 3. F.S. Basic concepts in meteorology, including atmospheric measurements, radiation, stability, precipitation, winds, fronts, forecasting, and severe weather. Applied topics include global warming, ozone depletion, world climates, weather safety, and atmospheric optics.

Mteor 298. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of the department cooperative education coordinator; sophomore classification. Required of all cooperative education students. Students must register for this course prior to commencing the work period.

Mteor 301. General Meteorology I. (4-0) Cr. 4. S. *Prereq:* Math 166, credit or enrollment in Phys 222. Global distribution of temperature, wind, and atmospheric constituents; atmospheric thermodynamics, radiative transfer, global energy balance, storms and clouds, introductory dynamics. Nonmajor graduate credit.

Mteor 306. Use of Weather Data in Agriculture. (Same as Agron 306.) See *Agronomy*. Nonmajor graduate credit.

Mteor 311. Introduction to Synoptic Meteorology. (1-2) Cr. 2. F. *Prereq:* 301. Concepts of weather map plotting and analysis. Introduction to forecasting and to the use of real-time UNIDATA computer products. Nonmajor graduate credit.

Mteor 321. Meteorology Internship. Cr. 1 or 2 each time taken, maximum of 3 cr. F.S.SS. *Prereq:* 311; junior or senior standing; permission of co-op program coordinator; acceptance by sponsoring agency. Supervised practical experience in a professional meteorological agency. Experiences may include providing weather information for radio, TV, utilities, government agencies, construction, or agribusiness.

Mteor 341. Atmospheric Physics I. (3-0) Cr. 3. F. *Prereq:* Phys 222, credit or enrollment in Math 266. Basic laws of the thermodynamics, thermodynamics of water vapor, mixtures of gases, stability, hydrostatics, cloud physics. Nonmajor graduate credit.

Mteor 342. Atmospheric Physics II. (3-0) Cr. 3. S. *Prereq:* 341. Precipitation physics, radar, atmospheric radiation, atmospheric optics, atmospheric electricity. Nonmajor graduate credit.

Mteor 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of the department cooperative education coordinator; junior classification. Required of all cooperative education students. Students must register for this course prior to commencing the work period.

Mteor 404. Global Change. (Dual-listed with 504; same as Agron 404, EnSci 404, Env S 404.) (3-0) Cr. 3. S. *Prereq:* Four courses in physical or biological sciences or engineering. Takle, Biogeochemical cycles, ozone chemistry, global energy balance, structure and circulation of the atmosphere and oceans, climate modeling, climate variability; and implications for agriculture, water resources, energy use, sustainable development, and public policy. Human dimensions and ethical issues of global environmental change. Nonmajor graduate credit.

Mteor 406. Climates of the Continents. (Same as Agron 406.) See *Agronomy*. Nonmajor graduate credit.

Mteor 407. Mesoscale Meteorology. (Dual-listed with 507; same as Agron 407.) (3-0) Cr. 3. *Prereq:* Math 166 and Mteor 454. Physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observations, analysis, and prediction of mesoscale phenomena. Nonmajor graduate credit.

Mteor 411. Synoptic Meteorology. (Dual-listed with 511.) (1-4) Cr. 3. F. *Prereq:* Credit or enrollment in 454. Current weather forecasting and discussion. Applications of atmospheric physics and dynamics in real-time weather situations. Use of UNIDATA computer products. Nonmajor graduate credit.

Mteor 417. Mesoscale Forecasting Laboratory. (Dual-listed with 517.) (0-6) Cr. 2. S. *Prereq: Credit or enrollment in 411.* Real-time computer analysis of current weather, with emphasis on small-scale features. Studies of severe weather, lake-effect snow, CSI, cold-air damming. Nonmajor graduate credit.

Mteor 432. Instrumentation and Measurements. (Dual-listed with 532.) (3-0) Cr. 3. S. *Prereq: Credit or enrollment in Stat 105, Math 266, Phys 222.* Measurement of meteorological variables and instruments used, including surface, upper air, and remote sensors; measurement errors, signal processing, recording and archiving; quality assurance. Nonmajor graduate credit.

Mteor 443. Dynamic Meteorology I. (3-0) Cr. 3. S. *Prereq: 341.* Conservation laws, governing equations, circulation and vorticity. Development of quasi-geostrophic theory. Nonmajor graduate credit.

Mteor 454. Dynamic Meteorology II. (3-0) Cr. 3. F. *Prereq: 443.* Planetary boundary layer, linear perturbation theory, atmospheric wave motions, baroclinic and convective instability, mesoscale circulations. Nonmajor graduate credit.

Mteor 455. General Circulation/Advanced Dynamics. (Dual-listed with 555.) (3-0) Cr. 3. S. *Prereq: 454.* General circulation of the atmosphere, including energy, momentum and hydrologic balances. Weather forecast and analysis systems. Nonmajor graduate credit.

Mteor 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq: 6 credits in meteorology, permission of instructor.* No more than 9 credits in Mteor 490 may be counted toward graduation.

- A. Synoptic Meteorology.
- B. Dynamic Meteorology.
- C. Physical Meteorology.

Mteor 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Mteor 499. Senior Research. (2-0) Cr. 2. F. Required of all senior meteorology majors. Research projects in collaboration with faculty. Written and oral presentations of results at the end of the semester.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Mteor 504. Global Change. (Dual-listed with 404; same as Agron 504.) (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering.* Biogeochemical cycles, ozone chemistry, global energy balance, structure and circulation of the atmosphere and oceans, climate modeling, climate variability; and implications for agriculture, water resources, energy use, sustainable development, and public policy. Human dimensions and ethical issues of global environmental change.

Mteor 505. Biometeorology. (Same as Agron 505.) See *Agronomy*.

Mteor 507. Mesoscale Meteorology. (Dual-listed with 407; same as Agron 507.) (3-0) Cr. 3. S. *Prereq: Math 166 and Mteor 454.* Physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observations, analysis, and prediction of mesoscale phenomena.

Mteor 511. Synoptic Meteorology. (Dual-listed with 411.) (1-4) Cr. 3. F. *Prereq: Credit or enrollment in 454.* Current weather forecasting and discussion. Applications of atmospheric physics and dynamics in real-time weather situations. Use of UNIDATA computer products.

Mteor 517. Mesoscale Forecasting Laboratory. (Dual-listed with 417.) (0-6) Cr. 2. S. *Prereq: Credit or enrollment in 411.* Real-time computer analysis of current weather, with emphasis on small-scale features. Studies of severe weather, lake-effect snow, CSI, cold-air damming. Materials fee.

Mteor 528. Atmospheric Physics. (Same as Phys 528.) See *Physics*.

Mteor 532. Instrumentation and Measurements. (Dual-listed with 432.) (3-0) Cr. 3. S. *Prereq: Credit or enrollment in Stat 105, Math 266, Phys 222.* Measurement of meteorological variables and instruments used, including surface, upper air, and remote sensors; measurement errors, signal processing, recording and archiving; quality assurance.

Mteor 542. Physical Meteorology. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: 342, Math 266, Phys 222.* Planetary atmospheres, radiative equilibrium models, radiative transfer, the upper atmosphere, remote sounding from satellites.

Mteor 543. Advanced Dynamic Meteorology I. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: 455.* The first half of a two semester sequence. Governing equations, scale analysis, simple types of wave motion in the atmosphere, instability theory.

Mteor 544. Advanced Dynamic Meteorology II. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: 543.* Continuation of 543. General circulation and dynamics of zonally symmetric circulations, atmospheric energetics, nonlinear dynamics of planetary waves.

Mteor 555. General Circulation/Advanced Dynamics. (Dual-listed with 455.) (3-0) Cr. 3. S. *Prereq: 454.* General circulation of the atmosphere, including energy, momentum and hydrologic balances. Weather forecast and analysis systems.

Mteor 561. Geophysical Fluid Dynamics. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: 455 or E M 378 or M E 335 or Phys 361.* Basic concept of rotating fluid dynamics, governing equations and boundary conditions, dynamics of vorticity, potential vorticity and geostrophic motion, wave motion in a rotating system, dynamics of Ekman and Stewartson layers, ocean circulation.

Mteor 590. Special Topics. Cr. 1 to 3 each time taken. *Prereq: Permission of instructor.* Topics of current interest.

- A. Boundary-layer Meteorology
- B. Tropical Meteorology
- C. Mesoscale Meteorology
- D. Global Climate Systems
- E. Climate Modeling
- F. Numerical Weather Prediction
- G. Satellite Observations
- H. Statistical Methods in Meteorology
- I. Field Observations
- J. Low Frequency Modes
- K. Cloud Physics
- L. Atmospheric Radiation

Courses for Graduate Students

Mteor 605. Micrometeorology. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: 443.* Atmospheric boundary layer, structure and dynamics. Turbulence, soil influences, measurements and empirical relations for wind and temperature profiles near the ground. Simulation of boundary layer structure and dynamics.

Mteor 699. Research. Cr. var.

Courses Offered at the Gulf Coast Research Laboratory (GCRL), Ocean Springs, Mississippi

The Gulf Coast Research Laboratory is affiliated with the University of Southern Mississippi. Iowa State students may register for the following University of Southern Mississippi/GCRL courses and transfer them to their ISU degree programs. Written permission of the ISU coordinator for the GCRL, 201 Bessey, is required for this arrangement. Inquire at 201 Bessey for further information.

MAR 300. Oceanography. (3-4) Cr. 5. SS. *Prereq: College algebra, Chem 164, Biol 202.* An integration of physical, chemical, biological, and general oceanography, to provide a multidisciplinary approach to the discipline.

MAR 300L. Oceanography. (3-4) Cr. 5. SS. *Prereq: College algebra, Chem 164, Biol 202.* An integration of physical, chemical, biological, and general oceanography, to provide a multidisciplinary approach to the discipline.

MAR 482. Coastal Marine Geology. (2-2) Cr. 3. SS. *Prereq: 6 credits in geology.* In-shore and near-shore geological processes, sedimentation patterns, and landform development.

MAR 482L. Coastal Marine Geology. (2-2) Cr. 3. SS. *Prereq: 6 credits in geology.* In-shore and near-shore geological processes, sedimentation patterns, and landform development.

Gerontology

(Interdepartmental Minor)

Advisory Committee: P. Keith, Coordinator; C. Cook, W. Franke, C. Jolly, C. Kundel, C. Mercier, N. Meredith, E. Schafer, M. Winter

The gerontology program is designed for students desiring careers in aging-related fields and for students interested in improving their understanding of aging persons in American society. Students are expected to take courses to develop the necessary interdisciplinary breadth which, in combination with other disciplinary training, can prepare them to work with the aged.

Graduates understand the ways in which individual and societal aging influence, and are impacted by, developments in their major field of study. They have an appreciation and understanding of the cross-disciplinary aspects of human aging.

Gerontology courses are offered in the interdepartmental gerontology program in the following participating departments and programs: Anthropology; Architecture; Biochemistry, Biophysics, and Molecular Biology; Economics; Educational Leadership and Policy Studies; Family and Consumer Sciences Education and Studies; Food Science and Human Nutrition; Health and Human Performance; Human Development and Family Studies; Political Science; Sociology; and Textiles and Clothing.

Undergraduate Study

Nancy Meredith, Coordinator

Undergraduate study in this program provides the student with an opportunity to develop a minor in gerontology. A balanced grouping of courses assists the student in developing both a sensitivity to the issues and the ability to synthesize ideas from the variety of disciplines important to the study of the aging process.

Undergraduate students may minor in gerontology by taking 16 semester hours of gerontology related courses. Nine of these credits must come from the following courses: Geron 377, 448, 461, 476. Students will participate in a prepracticum seminar, Geron 466, and will complete a supervised field practicum after all gerontology coursework is completed (Geron 467). A minimum of 3 semester credits must be selected from a list of supportive gerontology related courses. Supportive courses include units or topics related to aging and can be used to complement the student's major interests. The student's minor program must be approved by the undergraduate gerontology coordinator.

Graduate Study

Carolyn Kundel, Coordinator

A declared graduate minor in gerontology consists of a minimum of 12 credits taken from a list of acceptable courses, and from at least two departments. Nine of the 12 credits must be in courses that are focused specifically on aging. One 590 course (3 credits maximum) can be taken as part of the 12 credits. At least one member of the gerontology faculty will be on a student's advisory committee; this person must be a member of the Graduate Faculty. Contact the coordinator to determine whether courses other than those listed below are available.

Courses open for nonmajor graduate credit: 448, 471, 476.

Courses Primarily for Undergraduate Students

Geron 377. Aging and the Family. (Same as HD FS 377.) See *Human Development and Family Studies*.

Geron 448. Economics of Aging. (Same as HD FS 448.) See *Human Development and Family Studies*. Nonmajor graduate credit.

Geron 461. Life Course Sociology. (Same as Soc 461.) See *Sociology*.

Geron 463. Housing and Environments for the Elderly. (Dual-listed with 563; same as HD FS 463.) See *Human Development and Family Studies*.

Geron 466. Gerontology Prepracticum Seminar. (1-0) Cr. 1. F.S. Prereq: 9 credits in core courses for the gerontology minor and approval of the gerontology undergraduate coordinator. Prepracticum training for students planning a gerontology practicum. Exploration of possible agencies for the practicum, in-depth study of a selected agency, and development of goals and objectives for the practicum.

Geron 467. Gerontology Practicum. Cr. 3 to 6 each time taken. F.S. Prereq: 466, advance reservation. Supervised field experience related to aging. Offered on a satisfactory-fail grading basis only.

Geron 471. Design for All People. (Same as Arch 471.) See *Architecture*. Nonmajor graduate credit.

Geron 476. The Aged in American Society. (Same as Soc 476.) See *Sociology*. Nonmajor graduate credit.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Geron 534. Adult Development. (Same as HD FS 534.) See *Human Development and Family Studies*.

Geron 561. Life Course Research. (Same as Soc 561.) See *Sociology*.

Geron 563. Housing and Environments for the Elderly. (Dual-listed with 463; same as HD FS 563.) See *Human Development and Family Studies*.

Geron 566. Housing for Specific Groups. (Same as Arch 566.) See *Architecture*.

Geron 576. Sociological Perspectives on Aging. (Same as Soc 576.) See *Sociology*.

Geron 577. Aging and Intergenerational Relations. (Same as HD FS 577.) See *Human Development and Family Studies*.

Geron 600. Seminar. Cr. arr. F.S.SS.

Graduate Studies

No major is granted in Graduate Studies. At the recommendation of the major professor and/or the department chair, graduate students may enroll in the following graduate

courses to fulfill certain enrollment requirements.

Courses for Graduate Students

Gr St 600. Examination Only. Cr. R. Reserved for graduate students the term they take the final oral examination. Students must have completed all required coursework and not be registered for another course.

Gr St 601. Required Enrollment. Cr. R. Reserved for graduate students who must be registered for a particular term, but are not required to take additional coursework.

Gr St 680. Continuous Registration. Cr. R. Course may be repeated. Reserved for Ph.D. candidates only. See page 115 of this bulletin or see the *Graduate College Handbook* for specific requirements.

The Greenlee School of Journalism and Communication

John B. Eighmey, Chair of the School

Professors: Abbott, Beell, Eighmey, Emerson, Peterson, Smith

Professors (Emeritus): Blinn, Disney, Friederich, Gillette, Hvistendahl, Kunerth, Schwartz, Shelley, Wechsler

Associate Professors: Coon, Fowler, Geske, Haws, Mack, Niebauer, Prior-Miller, Redmond

Assistant Professors: Abraham, Appiah, Chadwick, Farnall, Rodriguez, Zhong

Assistant Professors (Adjunct): Vrchota

www.public.iastate.edu/~jlmc/

Undergraduate Study

The department was re-named the Greenlee School of Journalism and Communication by the State Board of Regents in 1998. The school offers work for the bachelor or arts in advertising and for the bachelor of arts or science degree in journalism and mass communication. It is also the home of communication studies, which offers work toward a bachelor's degree in speech communication. The unit, founded in 1905, has been continuously accredited every six years since 1948 by the Accrediting Council on Education in Journalism and Mass Communication and was reaccredited in 1998.

The Greenlee School of Journalism and Communication prepares its graduates for careers in both mass media and communication. Students receive a comprehensive education designed to allow them to function effectively in leadership roles in Iowa, the nation, and throughout the world. This education includes a broad foundation in the liberal arts and sciences, as well as proficiency in writing and critical thinking.

The School expects students to develop an emphasis or specialization to insure the depth necessary to succeed in the professional world of communication. Supporting work is designed to provide expertise and depth in

related content areas. Graduates of the School will be able to generate ideas, gather and interpret data and disseminate information. The School also prepares students throughout the university to be informed media participants and consumers.

To become a journalism and mass communication or advertising major, all students, including transfer students, must successfully complete JI MC 101, 110 and 201. Until these courses are successfully completed, students are designated as pre-majors.

English Proficiency Requirement

To graduate as a JI MC or an Advrt major, the student must either have achieved a score of 26 or higher on the ACT-English examination or passed the School's own English Usage Test. Also, to meet the University's English Proficiency requirement, JI MC majors must earn a grade of C or better in Engl 104 and 105 (or 105H) and a grade of C+ or better in JI MC 201 and 202 or 206. Advrt majors must earn a grade of C or better in Engl 104 and 105 (or 105H) and a grade of C+ or better in JI MC 201.

The Journalism and Mass Communication Major

The major in journalism and mass communication allows the student to pursue a general program of study or to select one of five emphases: electronic media studies, print media (magazine and newspaper), public relations/public information, science communication, or visual communication.

The student who majors in journalism and mass communication must earn at least 124.5 credits, with 45 credits earned at the 300 and 400 level, and a minimum of 33 credits coming from JI MC and Advrt courses. However, the student may earn as many as 40 credits in appropriate JI MC courses as long as six of those credits come from JI MC 101, 401, 461, 464, 474, 476, and 477. A minimum of 90 credits also must be earned in courses outside JI MC and Advrt and 65 of those credits coming from the basic liberal arts and sciences.

The Core for the Journalism and Mass Communication Major

Cr. Degree Requirements

Pre-Major Requirements (6 credits)

- | | |
|---|--|
| 3 | Mass Media and Society—JI MC 101 |
| R | Orientation to Journalism and Mass Communication—JI MC 110 |
| 3 | Reporting and Writing for the Mass Media—JI MC 201 |

Major Requirements (26-28 credits)

- | | |
|----------|---|
| 3 | Intermediate Reporting and Writing for the Mass Media—JI MC 202 or Reporting and Writing for the Electronic Media—JI MC 206 |
| 3 | Law of Mass Communication—JI MC 460 |
| 3 | Professional Media Internship—JI MC 499 |
| 11 to 12 | 300-level courses, at least one of which must be JI MC 306, 310, 321, 340, 342/342L/343L, 344, 346, 347, or 349 |
| 6 | Additional 400-level courses, at least one of which must be JI MC |

- 401, 406, 453, 454, 461, 462, 464, 474, 476, or 477.
- 1 Senior Seminar only for students in Public Relations emphasis (JI MC 492), Print emphasis (JI MC 494) and Electronic Media Studies (JI MC 495)
- 33-34 Total

To succeed as a media professional, the student needs a broad-based academic background that the department seeks to ensure by requiring students to take courses outside the department in both a designated area of concentration and specific enhancement areas.

JI MC majors must complete a designated area of concentration (DAC) made up of 24 credits, with at least 15 credits from the 300 level or above. This is a student-designed, adviser-approved grouping of courses excluding JI MC and Advrt that will meet the student's professional or academic interests. A second major outside substitutes for the DAC.

Enhancement courses are ones that the faculty has decided must be taken by the student to ensure a sufficiently broad education. Enhancement courses may also be used to fulfill the group requirements of the College of Liberal Arts and Sciences.

The Advertising Major

The student who majors in advertising must earn at least 124.5 credits, with 45 credits earned at the 300 and 400 level, and a minimum of 34 credits coming from JI MC and Advrt courses. However, the student may earn as many as 40 credits in appropriate JI MC and Advrt courses as long as six of those credits come from JI MC 101, 401, 461, 464, 474, 476, and 477. A minimum of 90 credits must also be earned in courses outside JI MC and Advrt with 65 of those credits coming from the basic liberal arts and sciences.

The Core for the Advertising Major

Cr. Degree Requirements

Pre-Major Requirements (9 credits)

- 3 Mass Media and Society, JI MC 101
- R Orientation to Journalism and Communication, JI MC 110
- 3 Reporting and Writing for the Mass Media, JI MC 201
- 3 Principles of Advertising, Advrt 230

Major Requirements (12 credits)

- 3 Strategic Planning, Advrt 301
- 3 Law of Mass Communication, JI MC 460
- 3 Select from JI MC 401, 406, 453, 454, 461, 462, 464, 474, 476, 477
- 3 Professional Media Internship, JI MC 499

Select 3-6 credits from:

- 3 Advertising Campaigns, Advrt 434
- 3 Advanced Advertising Campaigns, Advrt 435
- 3 Advanced Portfolio Practicum, Advrt 436

Major Electives/Options (12-15 credits)

Choose 9-12 credits from the following:

- 3 Electronic Media Production, JI MC 306

- 3 Fundamentals of Photojournalism, JI MC 310
- 3 Multimedia Production, JI MC 315
- 3 Public Relations Techniques, JI MC 321
- 3 Advertising Creativity, Advrt 334
- 3 Media Buying, Advrt 335
- 3 Media Sales, Advrt 336
- 2 + 2 Visual Principles & Lab, JI MC 342 & 342L
- 2 Intermediate Visual Principles Lab, JI MC 343L
- 3 Science Communication, JI MC 347
- 33-36—Total

To succeed as a media professional, the student needs a broad-based academic background that the School seeks to ensure by requiring students to take courses outside the School in both a designated area of concentration and specific enhancement courses.

Advertising majors must complete a designated area of concentration (DAC) made up of 25 credits with at least 15 credits from 300 level or above. Of the 25 credits, 10 credits are in prescribed courses and 15 credits are from a student-designed, adviser-approved grouping of courses excluding Advrt and JI MC that will meet the student's professional or academic interests. A second major outside of Advrt or JI MC may substitute for the student-designed, adviser-approved part of the DAC.

Enhancement courses are ones that the faculty has decided must be taken by the student to ensure a sufficiently broad education. Enhancement courses may also be used to fulfill the group requirements of the College of Liberal Arts and Sciences.

Communications Studies (ComSt) The communication studies program is a focused course of inquiry into the contemporary study of human communication. This program emphasizes applied communication theory and research in interpersonal, small group, organizational, and intercultural communication.

A communication studies option prepares students for graduate education and careers in business and industry. Students emphasizing communication studies should find their career opportunities enhanced in professions requiring applied communication expertise, e.g., human resource management, personnel, training and development, sales, management, public relations, organizational development, public information, business communication, and international and intercultural relations.

The following courses are required for an emphasis in communication studies: ComSt 101, 102, 203, 214 or 218, 301, 310, 311, 314, 317, 325, 404 or 414; Stat 101; Engl 302 or 309 or 314 or 415.

Minors

Journalism and Mass Communication.

JI MC minors are designed within each of the School's emphasis areas. See the School's literature or an adviser in JI MC or Advrt for more information.

To become a JI MC minor, the student must have achieved a score of 26 or higher on the

ACT-English examination or have passed the School's own English Usage Test and have earned a grade of at least a C+ in JI MC 201.

JI MC minors are required to complete at least 18 credits in JI MC courses. This includes 6 credits in the core (201 and 202 or 206), 6 credits from among 300-level courses, and 3 credits from among 400-level courses and 3 credits of JI MC (or Advrt) elective.

Advertising. To become an advertising minor, the student must have achieved a score of 26 or higher on the ACT-English examination or have passed the School's own English Usage Test and have earned a grade of at least a C+ in JI MC 201.

Advertising minors are required to complete at least 18 credits in Advrt and JI MC courses. This includes 9 credits in the core (JI MC 201, Advrt 230 and Advrt 301), and either Advrt 434 or 435 (3 credits), plus 6 additional credits at the 300-400 level in Advrt or related JI MC courses.

Communication Studies. The requirements for a minor in ComSt may be fulfilled by credit in ComSt 101 plus at least 15 additional hours, of which 9 credits are in courses numbered 300 or above. All 15 credits must be taken within communication studies. All credits taken for the minor must have a grade of 2.0 or higher. No credits in 290, 490, 493, 499, or 590 may apply toward the minor.

Graduate Study

The School offers work for the master of science degree with a major in journalism and mass communication. A minor is available to students taking major work in other departments.

The emphasis of the program is on the study of scientific and technological communication from both theoretical and professional skills perspectives.

Majors plan programs of study in one of three concentrations:

I. Science Communication—developing effective reporting and writing skills to disseminate information about science, technology, and agriculture to a range of publics through a variety of channels. Appropriate for media professionals and those with a science background.

II. Mass Communication in Science and Technology—the study of the theory, preparation, and use of media materials to transmit scientific, technological, and agricultural knowledge to the public. Appropriate for those interested in public information or international development communication.

III. Mass Communication as a Social Science—the study of the role and impact of mass communication on individuals and society, primarily from a social science perspective. Appropriate for those interested in studying the mass media from a variety of perspectives.

Students in all three concentrations have the option of writing a thesis or completing a creative component.

Core courses for students in the three concentrations are: JI MC 501, 502, 510, 601, and 650. Elective coursework is selected with approval of the student's program of study committee.

Students with bachelor's degrees in a variety of academic disciplines and with diverse professional experiences may be accepted into the program. However, students without a degree or experience in journalism or mass communication may be required to take additional coursework.

Courses open for nonmajor graduate credit: 460, 461, 462, 464, 474, 476, and 477.

Advertising (Advrt)

Courses Primarily for Undergraduate Students

Advrt 230. Advertising Principles. (3-0) Cr. 3. F.S.SS. *Prereq:* *Sophomore classification.* Historical, social, economic, and legal aspects of advertising. Evaluations of advertising research, media, strategy, and appeals. Study of the creation of print and broadcast advertising studied.

Advrt 301. Strategic Planning for Advertising and Public Relations. (3-0) Cr. 3. F.S. *Prereq:* *Advrt 230 or JI MC 220; majors must also have credit or concurrent enrollment in JI MC 201.* Prospect analysis, market segmentation, positioning, public opinion formation, communication strategy formation and development of critical thinking skills. Legal and ethical issues in advertising and public relations explored.

Advrt 334. Advertising Creativity. (2-2) Cr. 3. F.S. *Prereq:* *Advrt 230 or JI MC 220; and Advrt 301.* Development and execution of creative advertising materials. Copywriting, art direction and computer applications for print, broadcast and digital media. Creative strategy development, execution and evaluation.

Advrt 335. Advertising Media Buying. (2-2) Cr. 3. F.S. *Prereq:* *Advrt 230.* Concepts of media planning and selection in the development, execution and evaluation of advertising campaigns. Characteristics and capabilities of the advertising media. Utilization of market segmentation, consumer buying and media audience data bases.

Advrt 336. Advertising Media Sales and Management. (3-0) Cr. 3. S. *Prereq:* *Advrt 301 and Advrt 335.* Fundamentals of advertising media sales with emphasis on sales techniques, presentation skills and strengths of competing media. Includes development of sales and training materials for a variety of media. Sales simulations.

Advrt 434. Advertising Campaigns. (3-0) Cr. 3. F.S. *Prereq:* *334 and either 335 or JI MC 342L or 343L.* Development of advertising campaigns for business and social institutions. Projects involve budgeting, media selection, market analysis, campaign strategy, and creative execution.

Advrt 435. Advanced Advertising/Public Relations Campaigns. Cr. 1-3, to a maximum of 3 credits. S. *Prereq:* *Permission of instructor.* Preparation of materials for regional and national competitions.

Advrt 436. Advertising Portfolio Practicum. (0-6) Cr. 3. *Prereq:* *Advrt 334, portfolio review and permission of instructor.* Advanced advertising writing and design. Emphasis on creative strategy, problem solving and execution of creative materials in print, broadcast and on-line media for a variety of clients. Visit to advertising agencies. Field trip fee.

Communication Studies (ComSt)

(Administered by the Greenlee School of Journalism and Communication)

The following courses are part of the Speech Communication program. For more information, refer to that section.

Courses Primarily for Undergraduate Students

ComSt 101. Introduction to Communication Studies. (3-0) Cr. 3. F.S. An introduction to communication theory, the development and functions of communication, and a survey of interpersonal, small group, organizational, and intercultural communication.

ComSt 102. Introduction to Interpersonal Communication. (3-0) Cr. 3. F.S.SS. Application of communication principles, theory, and research to an examination of the process of interpersonal communication and the improvement of communication skills that are most relevant to a broad range of interpersonal settings.

ComSt 203. Introduction to Communication Research Methods. (3-0) Cr. 3. F. An introduction to basic research methods used by communication studies researchers. The course begins with an introduction to the development of theory and concludes with an analysis of methods used in a variety of communication contexts.

ComSt 214. Professional Communication. (3-0) Cr. 3. F.S. Communication theory and skill development in organizational settings. Emphasis on four oral communication competencies: interpersonal skill development, team and meeting facilitation, informational interviewing, and team presentations. Emphasis on self-assessment.

ComSt 218. Conflict Management. (3-0) Cr. 3. F.S.SS. Exploration of the relationship between communication and conflict. Communication theories, principles and methods associated with effective conflict management in interpersonal and organizational contexts.

ComSt 290. Special Projects. Cr. 1 to 2 each time taken, maximum of 4 credits. F.S.SS. *Prereq:* *3 credits in communication studies, permission of instructor.*

ComSt 301. Human Communication Theory. (3-0) Cr. 3. F. *Prereq:* *101.* In-depth examination of the major theories related to human communication with particular emphasis on those theories underlying interpersonal, small group, organizational, and intercultural communication.

ComSt 310. Intercultural Communication. (3-0) Cr. 3. F.S.SS. *Prereq:* *101 or 102, 203 or Psych 301 or Soc 302.* Examines the theories, principles and research on intercultural communication with the intent of enhancing cultural sensitivity and ability to recognize, accept, and adapt to cultural diversity. Interactive assignments.

ComSt 311. Interpersonal Communication: Theory and Research. (3-0) Cr. 3. F.S.SS. *Prereq:* *102 and 203 or Psych 301 or Soc 302.* A study of contemporary interpersonal communication theories and research through the examination of published scholarship. Emphasis on relational development research including initiation, maintenance, conflict management, and dissolution.

ComSt 314. Organizational Communication. (3-0) Cr. 3. F.S.SS. *Prereq:* *101 or 102; and either 203 or Psych 301 or Soc 302.* Theory and research in organizational communication; strategies for assessing and improving individual and organizational communication effectiveness; and an understanding of how organizational meaning is created and sustained through human communication.

ComSt 317. Small Group Communication. (3-0) Cr. 3. F.S.SS. *Prereq:* *101 or 102; and either 203 or Psych 301 or Soc 302.* Theory and research in small group communication; application to group decision-making and leadership. Includes communication analyses of groups and teams.

ComSt 325. Nonverbal Communication. (Same as Ling 325, Sp Cm 325.) (3-0) Cr. 3. F.S.SS. *Prereq:* *101 or 102; and either 203 or Psych 301 or Soc 302.* A survey of theory and research in nonverbal communication; exploration of nonverbal codes and covert subcodes; function of nonverbal communication in various contexts. Application of material through student-designed investigations.

ComSt 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of instructor, junior or senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

ComSt 404. Seminar in Communication Studies. (Dual-listed with 504.) Cr. var. 1-3 each time taken. *Prereq:* *12 credits in ComSt or permission of instructor.* Special topic exploring select communication theory and research.

- A. Communication Theory or Research
- B. Interpersonal Communication
- C. Small Group Communication
- D. Organizational Communication
- E. Intercultural Communication
- F. Nonverbal Communication

ComSt 414. Organizational Communication Training and Development. (3-0) Cr. 3. S. *Prereq:* *314, recommended I Tec 202.* Application of organizational communication theory and research to consulting and training and development in contemporary organizations. Nonmajor graduate credit.

ComSt 490. Independent Study. Cr. 1 to 3 each time taken, maximum of 6. F.S.SS. *Prereq:* *9 credits in communications studies and junior classification.* Application must be submitted for approval the semester prior to the independent study.

ComSt 493. Workshop. Cr. 1 to 3 each time offered. *Prereq:* *12 credits in communication studies courses.* Offered irregularly to explore special topics not adequately covered in other course offerings. Materials fee.

ComSt 497. Senior Seminar. (3-0) Cr. 3. S. *Prereq:* *15 credits in ComSt; Stat 101 and either ComSt 203 or Psych 301 or Soc 302.* Directed study of a communication issue identified by each student. Students synthesize relevant theory and research culminating in a senior project/paper.

ComSt 499. Communication Internship. Cr var. 1 to 3 each time taken, maximum of 6. F.S.SS. Requires a professional situation that provides a variety of experiences. Four hundred hours of on-site work is required for 3 hours credit. Registration by application only. Application must be submitted to Communication Studies faculty adviser for approval the semester prior to the internship.

Courses Primarily for Graduate Students, open to qualified undergraduates

ComSt 504. Seminar in Communication Studies. (Dual-listed with 404.) Cr. var. 1 to 3 each time taken. *Prereq:* *9 credits in ComSt or permission of instructor.* Special topic exploring select communication theory and research.

- A. Communication Theory and Research
- B. Interpersonal Communication
- C. Small Group Communication
- D. Organizational Communication
- E. Intercultural Communication
- F. Nonverbal Communication

ComSt 590. Special Topics. Cr. 1 to 4 each time taken. Application must be submitted for approval the semester prior to the independent study.

Journalism and Mass Communication (JI MC)

Courses Primarily for Undergraduate Students

JI MC 101. Mass Media and Society. (3-0) Cr. 3. F.S.SS. Communication models and their application to the mass media; the mass communication process; organization, characteristics and responsibilities of the mass media; media-related professional operations.

JI MC 110. Orientation to Journalism and Mass Communication. (1-0) Cr. R. F.S. Orientation to career opportunities, emphasis areas, and requirements in the advertising and journalism and mass communication curricula.

Jl MC 201. Reporting and Writing for the Mass Media. (1-4) Cr. 3. F.S.SS. *Prereq: English 105 (or testout) and either a score of 26 or higher on the ACT-English examination or satisfactory performance on the English Usage Test administered by the School before registering for the course.* News judgment and news gathering for the mass media. Writing and reporting techniques, including backgrounding, speech coverage, interviewing, and writing multi-source stories.

Jl MC 202. Intermediate Reporting and Writing for the Mass Media. (2-3) Cr. 3. F.S. *Prereq: C+ or better in Jl MC 201.* Covering standard news assignments and beats, developing public opinion stories, reporting and writing complex stories.

Jl MC 205. Publicity Methods. (3-0) Cr. 3. F.S. *Prereq: Engl 105.* Communication and publicity fundamentals and the use of media for publicity purposes. Publicity campaigns. Preparing releases for print and broadcast: basics of publication layout. Not available to Jl MC and Advrt majors.

Jl MC 206. Reporting and Writing for the Electronic Media. (2-3) Cr. 3. F.S. *Prereq: C+ or better in Jl MC 201.* Researching, organizing, and writing for audio, video, and film media. Basic principles of news, information, and entertainment programming, content, and structure.

Jl MC 220. Principles of Public Relations. (3-0) Cr. 3. F.S. *Prereq: Sophomore classification.* Public relations in business and other organizations, functions, processes, and management: attitudes, public opinion and persuasion: tools of the public relations and corporate communications practitioner, management of change in contemporary society.

Jl MC 306. Electronic Media Production. (2-3) Cr. 3. F.S. *Prereq: C+ or better in Jl MC 201.* Creation of short video productions using basic studio equipment and procedures. Materials fee.

Jl MC 308. Video Field Production Techniques. (2-3) Cr. 3. S. *Prereq: 206, 306.* Basic field techniques in single-camera video, directing, shooting, editing, and writing. Materials fee.

Jl MC 310. Fundamentals of Photojournalism. (1-3) Cr. 3. F.S. *Prereq: Jl MC 201 or permission of instructor.* Basic photojournalism and photo techniques. Includes camera operation, lighting and composition, lens and depth of focus, and photo reproduction techniques for print, broadcast, or computer-mediated applications. Basic use of digital imaging and editing software. Materials fee.

Jl MC 315. Multimedia Production. (3-0) Cr. 3. F.S. *Prereq: 342L or 343L.* Concepts and principles for evaluating, constructing, and designing information for the World Wide Web and other computer-mediated communication systems. Explores the use of computer-generated animation and graphics, audio and video. Issues of ethics and ownership of work pertinent to the new media are discussed.

Jl MC 321. Public Relations/Corporate Communications Techniques. (2-3) Cr. 3. F.S. *Prereq: 201, and 220 or Advrt 230.* Application of the techniques of public relations and corporate communications, including news releases, publications, print and broadcast materials.

Jl MC 340. Magazine Reporting and Writing Practicum. (2-2) Cr. 3. F. *Prereq: 202.* Practical experience on student magazines. Instructor critiques of student work.

Jl MC 341. Contemporary Magazine Publishing. (3-0) Cr. 3. F.S. *Prereq: Sophomore classification.* Analysis of magazine industry and of specific audiences served. Editorial procedures and policies. Advertising, circulation, and history of the industry. Individual study of magazines.

Jl MC 342. Visual Principles for Mass Communicators. (2-0) Cr. 2. F.S. *Prereq: Sophomore classification.* Understanding of the visual message. Visual perception, design syntax, design elements and how they fit in the visual communication of mass media.

Jl MC 342L. Laboratory in Basic Visual Principles. (0-2) Cr. 2. F.S. *Prereq: 201 or permission of instructor, and credit or enrollment in 342.* Introduction to

desktop publishing, beginning techniques of layout in a step-by-step process; application of visual principles to simple, one-page print projects.

Jl MC 343L. Laboratory in Intermediate Visual Principles. (0-2) Cr. 2. S. *Prereq: 201 or permission of instructor, and credit or enrollment in 342, and 342L or its equivalent.* Application of more advanced features of desktop publishing and other document-enhancing software. Production of newsletters, multi-page brochures and other documents.

Jl MC 344. Depth Reporting and Writing. (2-2) Cr. 3. F. *Prereq: 202 or 206.* Developing comprehensive news features and magazine articles on current issues. Emphasis on writing excellence.

Jl MC 346. Public Affairs Reporting. (2-2) Cr. 3. S. *Prereq: 202 or 206.* Reporting on government, business, and other institutions: identification of and access to public records; investigative reporting techniques; developing major stories on public agencies and issues for print and broadcast media.

Jl MC 347. Science Communication. (Dual-listed with 547.) (2-2) Cr. 3. S. *Prereq: 202 or 206 for Jl MC majors; Advrt 334 for Advrt majors; permission of instructor for nonmajors.* Researching, reporting and writing about science and technology for the mass media.

Jl MC 349. Print Media Editing. (1-5) Cr. 3. F.S. *Prereq: 202 or 206.* Editing copy for newspapers, magazines and corporate publications. Headline and title writing. Editorial decision-making. Role of editor in working with reporters and authors.

Jl MC 353. Information Presentation and Performance. (2-2) Cr. 3. F. *Prereq: 306.* Presentation style for the electronic media. Exploration of techniques for the narrator, announcer, news anchor, and interviewer/host. Materials fee.

Jl MC 354. Intermediate Electronic Media Production. (2-3) Cr. 3. S. *Prereq: 306.* More detailed applications of audio and visual techniques and principles for integrating studio and field video with computer-generated graphics and special effects in laboratory and field projects. Materials fee.

Jl MC 355. Reporting for Television. (2-3) Cr. 3. F. *Prereq: 206, 306.* Television news techniques; reporting with electronic newsgathering equipment, writing news scripts, editing scripts and video tape; producing news and public affairs programs. Materials fee.

Jl MC 390. Workshop. Cr. 1 each time taken, maximum of 3. SS. Offered as elective credit only. Check School for course availability. Offered on a satisfactory-fail grading basis only.

- C. Basic Desktop Publishing
- D. Intermediate Desktop Publishing
- E. Photography and Photo Lab Management
- H. Advanced Desktop Publishing
- I. Advising Publications
- J. Publications Practicum
- Q. Teaching High School Journalists
- R. Computer Applications for Journalism.

Jl MC 401. Mass Communication Theory. (3-0) Cr. 3. F.S. *Prereq: 6 credits in social science.* Theory and research in mass communication processes and effects; the scientific process; methods of measuring, evaluating and reporting mass communication research.

Jl MC 406. Media Management. (Dual-listed with 506.) (3-0) Cr. 3. S. *Prereq: Junior classification.* Decision-making functions of media. Basic media market analysis, media organization and management, circulation and audience development, technological developments affecting management decisions, relationships with labor, and regulatory agencies that affect media operation.

Jl MC 424. Public Relations Campaigns. (Dual-listed with 524.) (3-0) Cr. 3. F.S. *Prereq: 220, 321.* Development of public relations and corporate communications campaigns for business and social institutions. Projects involve budgeting, media selection, campaign strategy, and creative execution.

Jl MC 453. Electronic Media Technology, Public Policy, and Responsibility. (3-0) Cr. 3. Alt. S.,

offered 2001. *Prereq: Junior classification.* Issues and policies affecting the historical and contemporary development of electronic media and their technologies.

Jl MC 454. Critical Analysis and History of the Moving Image. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: Junior classification.* Evolution of video, television, film, computers and related technologies and the implication of such evolution on future development.

Jl MC 455. Corporate and Industrial Video Production. (2-2) Cr. 3. F. *Prereq: 354 or 355.* Production policies, procedures, and practices involved in taking an informational video project from conception to completion. Theory and practice. Materials fee.

Jl MC 460. Law of Mass Communication. (3-0) Cr. 3. F.S.SS. *Prereq: 201 and 6 credits in social science.* First Amendment law, libel, privacy, obscenity, contempt, copyright, trademark, the Federal Communications Act: laws affecting advertising, legal publication, and other business activities of the media, including the Internet. Nonmajor graduate credit.

Jl MC 461. History of American Journalism. (3-0) Cr. 3. F.S. *Prereq: 6 credits in the humanities or social sciences.* Role of the media in shaping the social, economic, and political history of America; impact of change in these areas on the development, traditions, and philosophies of the media. Nonmajor graduate credit.

Jl MC 462. Media Ethics, Freedom, Responsibility. (3-0) Cr. 3. F.S. *Prereq: 201.* Media ethics and performance: functions of the media in relation to the executive, judicial and legislative branches of government; agencies of media criticism; right to know versus right to privacy. Nonmajor graduate credit.

Jl MC 464. Journalism and Literature. (3-0) Cr. 3. F. *Prereq: 6 credits in history or literature.* A study of journalism's impact on literary writing and literature's impact on journalism, as seen through the works of such American author/journalists as Ernest Hemingway, Walt Whitman, Theodore Dreiser, Truman Capote, Joan Didion. Nonmajor graduate credit.

Jl MC 474. Impact of Communication Technology on People and Societies. (Dual-listed with 574; same as T SC 474.) (3-0) Cr. 3. F. *Prereq: 6 credits in social science.* Present and potential effects of increasingly sophisticated modes of mass communication on people, institutions, and societies.

Jl MC 476. World Communication Systems and International Development. (Dual-listed with 576.) (3-0) Cr. 3. F. *Prereq: 6 credits in social science.* World communication systems, newsgathering and dissemination agencies, factors determining flow and volume of news. Comparative analysis of role of traditional and mass media in developed and developing countries.

Jl MC 477. Ethnicity, Gender, Class and the Media. (3-0) Cr. 3. S. *Prereq: Junior classification.* Portrayals of ethnic groups, genders, and classes in the media in news, information and entertainment; the effects of mass media on social issues and population groups. Nonmajor graduate credit.

Jl MC 490. Independent Study in Communication. Cr. arr. *Prereq: 6 credits in Jl MC or Advrt, permission of instructor and completion of a proposal form.* No more than 6 credits of 490 may be used toward a degree in journalism and mass communication or advertising. Students may study problems associated with a medium, a professional specialization, a philosophical or practical concern, a reportorial method or writing technique, or a special topic in their field.

- I. Media Studies
 - A. Book Publishing
 - B. Electronic Media Studies
 - C. Magazine
 - D. Newspaper
- II. Professional Specialization
 - E. Advertising
 - F. Communication Technology
 - G. Education

Health and Human Performance

Jerry R. Thomas, Chair of Department

Professors: Anderson, Mathes, Moore, J. Thomas

Distinguished Professors (Emeritus): Forker, Toman

Professors (Emeritus): Frye, Hutchison, Schneider

Professors (Emeritus Adjunct): Beran

Associate Professors: Conover, Cooney, Engelhorn, Franke, King, Sharp, K. Thomas

Assistant Professors: Baker, Derrick, Kohut, McLean, Murdoch, Rhea, Sanda, Schabel, Symons, Trail

Assistant Professors (Collaborators): Buck

Assistant Professors (Emeritus): McDonald

Instructors (Adjunct): Coberley, Crowe, Harklau, Lee, Lynn, McVan, Meier, Murphy, Pak, Power, Pyle, Randall

Instructors (Collaborators): Deeter

Undergraduate Study

Health Studies. For the undergraduate curriculum in community health education leading to the degree of bachelor of science, see *College of Education, Curricula*. The community health education program is designed to prepare students for professional involvement in programs which incorporate health services and the educational process. Typical employment settings include city, county, regional, and state health departments; hospitals and clinics; voluntary organizations, and private businesses which focus on health promotion or offer health education as a benefit to employees. The following options are available:

- Option 1 Community/Public Health
- Option 2 Substance Abuse Prevention
- Option 3 Wellness/Fitness

Course work is available which meets the current educational requirements for certification as a Prevention Specialist as established by the Iowa Board of Substance Abuse. See the departmental advising office for details.

Students interested in teaching may qualify to teach health education as a second teaching area provided that licensure requirements are met in another subject area (see *Teacher Education, Requirements for Areas of Specialization*).

Introductory courses in health studies offer opportunities for learning experiences in personal and community health, drug education, and emergency health care.

The department offers a minor in health studies which may be earned by completing the following: H S 105, 110, 215, 310, 350, 430 or Ex Sp 440; and three additional credits selected from: H S 390; HD FS 276, 373, 377; FS HN 167; Psych 360; Zool 258.

Dance. Coursework in dance provides opportunities for students to develop an under-

- H. Honors
- I. Media Management
- K. Public Relations
- L. Visual Communication
- III. Problems and Methods
- M. Contemporary Issues
- N. Ethics and Responsibility
- O. Special Communication (Agriculture, Family and Consumer Sciences, Engineering, Science)
- P. International Communication
- Q. History and Literature
- R. Law
- S. Public Opinion
- T. Research Methods
- IV. Technique and Style
- U. Documentary
- V. Persuasion and Criticism
- W. Public Affairs Reporting
- Y. Internet Issues and Applications

JI MC 492. Professional Seminar—Public Relations. (2-0) Cr. 1. 8 weeks. F.S. *Prereq: Junior or senior classification.*

JI MC 494. Professional Seminar—Print Media (Magazine, Newspaper). (2-0) Cr. 1. 8 weeks. S. *Prereq: Junior or senior classification.*

JI MC 495. Professional Seminar—Electronic Media Studies. (2-0) Cr. 1. 8 weeks. S. *Prereq: Junior or senior classification.*

JI MC 499. Professional Media Internship. Cr. 3. *Prereq: JI MC 202 or 206 or Advrt 301, junior classification and adviser's formal approval of written proposal.* Required of all JI MC and Advrt majors. A 400-hour internship in the student's journalism and mass communication or advertising specialization. Grade based on employer evaluation and student report. Satisfactory-fail grade, based on employer evaluation and student report. Available only to JI MC and Advrt majors.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

JI MC 501. Theories of Mass Communication. (3-0) Cr. 3. F. *Prereq: 6 credits in social science.* Examination of major areas of research activity and theoretical development related to organization, functions, and effects of mass communication.

JI MC 502. Communication Research Methods. (3-3) Cr. 4. S. *Prereq: 501.* An examination of quantitative and qualitative research methods, including legal, participant observation, historical, survey, content analysis and experimental research.

JI MC 504. Advanced Journalistic Methods. (2-2) Cr. 3. S. *Prereq: 201 or equivalent professional work.* Reporting complex issues, situations, and specialized topics.

JI MC 506. Media Management. (Dual-listed with 406.) (3-0) Cr. 3. S. *Prereq: 6 credits in social science (economics highly recommended).* Decision-making functions of media. Basic media market analysis, media organization and management, circulation and audience development, technological developments affecting management decisions, relationships with labor, and regulatory agencies that affect media operation.

JI MC 510. Strategies of Communication. (3-0) Cr. 3. S.SS. *Prereq: 501 or equivalent social science theory.* The process of developing professional communication and persuasion strategies, with emphasis on problem definition, behavioral specification of objectives, situation analysis, strategy formulation, and justification through application of communication theories and research results.

JI MC 520. Public Relations Theory and Methods. (3-0) Cr. 3. S. *Prereq: 501.* Theories and research methods applied to the study and practice of public relations.

JI MC 521. Theories of Visual Communication. (2-2) Cr. 3. F. *Prereq: 6 credits in social science and permission of instructor.* Introduction to the study of picture-based media (film, television, photography, advertising, etc.). Exploration of theoretical concepts of vision and perception, visual literacy, visual lan-

guage, visual persuasion/manipulations, and the cultural implications of visual images.

JI MC 524. Public Relations Campaigns. (Dual-listed with 424.) (3-0) Cr. 3. F. *Prereq: 520.* Development of public relations and corporate communications campaigns for business and social institutions. Projects involve budgeting, media selection, campaign strategy, and creative execution.

JI MC 534. Advertising Campaigns. (3-0) Cr. 3. F.S. *Prereq: 334, 335, and permission of instructor.* Development of advertising campaigns for business and social institutions. Projects involve budgeting, media selection, market analysis, campaign strategy, and creative execution.

JI MC 547. Science Communication. (Dual-listed with 347.) (2-2) Cr. 3. S. *Prereq: 6 credits in science and permission of instructor.* Researching, reporting and writing about science and technology for the mass media.

JI MC 561. Media and Society: Interrelationships. (3-0) Cr. 3. F. *Prereq: 6 credits in social science.* Media functions in a democratic society; conflicts between the media and social institutions; ethical and social controls on the media.

JI MC 574. Impact of Communication Technology on People and Societies. (Dual-listed with 474; same as T SC 574.) (3-0) Cr. 3. F. *Prereq: 6 credits in social science.* Present and potential effects of increasingly sophisticated modes of mass communication on people, institutions, and societies.

JI MC 576. World Communication Systems and International Development. (Dual-listed with 476.) (3-0) Cr. 3. F. *Prereq: 6 credits in social science.* World communication systems, newsgathering and dissemination agencies, factors determining flow and volume of news. Comparative analysis of role of traditional and mass media in developed and developing countries.

JI MC 590. Special topics. Cr. arr. *Prereq: Permission of instructor.*

- A. Media Studies
- B. Professional Specialization
- C. Research Problems and Methods
- D. Technique and Style
- E. Specialized Communication

JI MC 591. Professional Internship. (0-6) Cr. 2. F.S.SS. *Prereq: 201 or permission of instructor.* Supervised internship experience. Offered on a satisfactory-fail grading basis only.

JI MC 599. Creative Component. Cr. var. *Prereq: Approved proposal.*

Courses for Graduate Students

JI MC 601. Introduction to Graduate Study in Journalism and Communication. (1-0) Cr. R. F. *Prereq: Graduate classification.* Overview of advanced study in journalism and communication, with special emphasis on requirements for obtaining the master of science degree.

JI MC 650. Seminars in Mass Communication. Cr. 1 to 3 each.

- A. Audiences and Effects
- B. Communication Technology
- C. Professional Communication
- D. Development Communication
- E. Evaluation Methods
- F. International Communication
- G. Mass Communication History
- H. Mass Communication Law
- I. Media Management
- J. Research Methods
- K. Society and Mass Communication
- L. Teaching Journalism and Mass Communication
- M. Visual Communication
- N. Broadcast Communication
- O. Communication Theory

JI MC 699. Research. Cr. var.

standing and appreciation of dance as part of a liberal education. Those interested in teaching dance and physical education in the public schools may major in exercise and sport science (teacher licensure option) and minor in dance. An individualized program in dance is also available through the General Studies in Exercise and Sport Studies Option.

An interdisciplinary Performing Arts major with a dance emphasis is available through the College of Liberal Arts and Sciences. For further information see Index, *Theatre and Performing Arts*.

The department offers a minor in dance that may be earned by completing the following: Dance 220, 222, 270, 320, 360, 384 or 386, and three additional credits selected from dance courses numbered 200 or above. Credit for both Dance 385 and 386 may not be applied toward a dance minor. Participation in Orchestral I or II is recommended.

Exercise and Sport Science. For the undergraduate curriculum in exercise and sport science leading to the degree of bachelor of science, see *College of Education, Curricula*. The curriculum in exercise and sport science has three facets: the general education component, the human movement core, and a specialization option (See *College of Education, Curriculum in Exercise and Sport Science* for information on minimum grade requirements in core courses and minimum requirements for admission to professional options). The following options are available: 1. teacher licensure (7-12 or K-12), 2. exercise science, 3. athletic training, 4. sport management, and 5. general exercise and sport studies.

Graduates of the teacher licensure programs will demonstrate an understanding of human movement in relation to anatomy, physiology, biomechanical, developmental, sociological, and psychological considerations. A graduate will understand how students learn motor skills and will be able to design, evaluate, and modify tasks and experiences for diverse audiences. Graduates also will be able to determine the appropriateness of various teaching styles, instructional strategies, and learning experiences with respect to curriculum goals and the needs of individual students.

To be accepted into the teacher education program, students must be approved by the departmental committee and the College of Education Teacher Education Committee. See the *HHP Teacher Licensure Handbook* for GPA, course work, credits, field experience, and ACT or PPST score requirements for admission to the departmental program. See the *Teacher Education* section for information on admission to the University Teacher Education Program. Details are available from the department advising office.

Several options are offered for students who are interested in the study of human movement as preparation for professional roles other than public school teaching.

The exercise science option leads toward professional roles as directors and leaders in the fitness field in corporate, recreational, clinical, or institutional settings. Graduates of this option understand the immediate and long-

term effects of physical activity, especially as they relate to improving and maintaining human health. Graduates are able to evaluate a person's physical fitness, prescribe safe and effective exercise programs tailored to an individual's needs and goals, and to effectively supervise these programs.

The athletic training option prepares students for the NATA certification examination or for graduate work in athletic training. Graduates of this option will effectively use their understanding of anatomy, kinesiology, physiology, sport psychology, and nutrition to plan strategies aimed at the prevention of injuries. When injuries do occur, they will be able to provide emergency care and to employ appropriate assessment techniques, treatment modalities, and rehabilitation strategies.

The sport management option serves students seeking entry-level positions in sport or fitness related businesses or organizations. Graduates of the sport management program will understand the structure, function, and impact of the sport industry on the community, as well as the social and ethical issues facing sport management professionals. Based on their understanding of principles of managing sport organizations, graduates will be able to critically analyze sport environments, conduct feasibility studies, develop marketing plans, and communicate effectively with others in sport organizations, health and fitness industries, and other sport and recreation agencies.

The general exercise and sport studies option is designed to allow students to take coursework outside the department to support and enhance an individualized program in such areas as sport psychology, sports information and promotion, pre-physical therapy, and other allied health and sport-related fields.

The department offers minors in athletic training and in athletic coaching. The athletic training minor may be earned by completing the following: Ex Sp 220, 221, 224, 225, 226, 227, 323, 326, 327, 355, 425, 455; H S 110, 215; FS HN 167.

The athletic coaching minor may be earned by completing the following: Ex Sp 220, 258, 355 or 356, 365, 455 or 456, Zool 155, Psych 230; and 315.

Endorsement to Coach Interscholastic Athletics. The State Department of Education has provided for the endorsement of licensed teachers for the coaching of athletic teams in schools. The endorsement does *not* lead to licensure to teach physical education. For requirements of the program, leading to the coaching endorsement, see *Teacher Education, Requirements for Areas of Specialization*.

Basic Activity Instruction Program. The department offers a wide selection of beginning, intermediate, and advanced courses in the areas of aquatics, dance, and sports. These courses are designed to serve general education purposes for all students.

Graduate Study

The department offers work for the degree of master of science with a major in exercise and sport science and minor work to students taking major work in other departments.

The normal prerequisite to major graduate work is the satisfactory completion of a curriculum essentially equivalent to that required of undergraduate students in exercise and sport science at this university. However, it is possible for students to qualify for graduate study even though undergraduate preparation has been in a related area.

A student in the graduate program may select either a thesis or nonthesis option. Specific information about the requirements for either degree option is available from the departmental office.

The department participates in the interdepartmental minor in gerontology (see *Index*).

Courses open for nonmajor graduate credit: Ex Sp 355, 393, 455, 465, 475.

Courses Primarily for Undergraduate Students

Athletics (Ath)

Ath 101. Intercollegiate Athletics. Cr. 1 in any one semester. Limited to 1 credit per year to a maximum of 4. F.S. Prereq: *Permission of head coach*. Offered on a satisfactory-fail grading basis only. Credit for a sport section of Ath 101 may not be applied toward graduation if credit is also received for P E 166 or 167 or any skill technique course in the same sport.

- A. Baseball (men)
- B. Basketball (men)
- C. Basketball (women)
- D. Cross Country (men)
- E. Cross Country (women)
- F. Football (men)
- G. Golf (men)
- J. Gymnastics (women)
- K. Softball (women)
- L. Swimming/Diving (men)
- M. Swimming/Diving (women)
- O. Tennis (women)
- P. Track and Field (men)
- Q. Track and Field (women)
- R. Volleyball (women)
- S. Wrestling (men)
- T. Golf (women)
- U. Soccer (women)

Health Studies (H S)

H S 105. First Aid and Emergency Care. (1-2) Cr. 2. F.S. Discussion and application of the basic techniques of administering first aid and cardiopulmonary resuscitation. ARC certification available. Materials fee.

H S 110. Personal and Consumer Health. (3-0) Cr. 3. F.S. Physical, mental, and social aspects of health as a basis for understanding and preventing health problems. False and misleading advertising and effects of cultists and fanatics on consumer health. Study of legislation and agencies concerned with consumer protection and health insurance.

H S 215. Drug Education. (3-0) Cr. 3. Prereq: *Psych 101 or 230*. Use and abuse of mood modifying substances in contemporary society. Includes study of tobacco, alcohol, and other drugs.

H S 250. Health and Human Performance Orientation. (1-0) Cr. R. (Same as Ex Sp 250.) See *Exercise and Sport Science*.

H S 255. Foundations in Health Education. (1-0) Cr. 3. A review of the development of health education as a profession, CHES, foundational theory and skills in health education.

H S 275. Health Education in the Elementary School. (3-0) Cr. 3. Prereq: *HD FS 102 or 226*. An

overview of school health services, healthful school living, and health instruction for teachers at the elementary level. Credit for both 275 and 375 may not be applied toward graduation.

H S 292. Acquired Immune Deficiency Syndrome and Sexually Transmitted Diseases. (3-0) Cr. 3. An introductory, nontechnical examination of the biological, social, psychological, and ethical aspects of AIDS and sexually transmitted diseases.

H S 294. Health Issues for Women. (3-0) Cr. 3. SS. Examines health and health care issues related to women.

H S 305. Instructor's First Aid and Cardiopulmonary Resuscitation. (1-2) Cr. 2. *Prereq:* 105, *current Standard First Aid and Community CPR Certification.* Discussion and practice of skills needed to teach first aid and cardiopulmonary resuscitation. ARC certification available.

H S 310. Community and Public Health. (3-0) Cr. 3. *Prereq:* 110. Introduction to community health problems, programs of prevention, environmental health agencies, and health services. Study of local, state, and national community health agencies, their purposes and functions.

H S 350. Human Diseases. (3-0) Cr. 3. *Prereq:* 110. Discussion of disease process and ill-health in the twentieth century. Emphasis on epidemiology, prevention, treatment, and the understanding of the etiology of communicable and noncommunicable diseases.

H S 375. Teaching-Learning Process in Health Education. (3-0) Cr. 3. *Prereq:* 105, 110, 215. Principles, methods, materials, and resources involved in the teaching of health. Includes organization and development of the health education curriculum (K-12). Credit for both 275 and 375 may not be applied toward graduation.

H S 390. Administration of the School Health Program. (3-0) Cr. 3. *Prereq:* 310, 375. History and legal basis of school health programs. Procedures for developing, organizing, administering, and evaluating a modern program of health services, healthful school living, and health instruction. Includes school-community relationships.

H S 395. Substance Abuse Prevention: Theories and Professional Practice. (3-0) Cr. 3. *Prereq:* 215. Current approaches to substance abuse prevention programs; examination of risk and resiliency factors in school, community, and institutional contexts; examination of legal and ethical concerns; and consideration of career and professional opportunities in the substance abuse prevention field.

H S 401. Job Search Skills and Strategies. (1-0) Cr. R. (Same as Ex Sp 401.) See *Exercise and Sport Science.*

H S 417. Supervised Teaching in Health Education in the Secondary School. Cr. var. F.S. *Prereq:* 375. Advance registration required.

H S 418. Supervised Teaching in Health Education in the Elementary School. Cr. var. F.S. *Prereq:* 375. Advance registration required. Offered on a satisfactory-fail grading basis only.

H S 430. Community Health Program Development. (3-0) Cr. 3. *Prereq:* 310. Techniques of needs assessment, program design, administration, and evaluation of community health education programs in various settings.

H S 488. Directed Field Experience in Health Education. Cr. 10-12. *Prereq:* 310. Advance registration required. Supervised experience in health education. Offered on a satisfactory-fail grading basis only.

H S 490. Independent Study. Cr. 1 to 6, maximum of 6. *Prereq:* 6 *credits in health studies and permission of coordinator.*

Dance (Dance)

Dance 120. Modern Dance I. (0-3) Cr. 1. F.S. Introduction and practice of basic dance concepts, including preparatory techniques and guided creativity problems. No previous modern dance experience required. Materials fee. Offered on a satisfactory-fail grading basis only.

Dance 130. Ballet I. (0-3) Cr. 1. F.S. Introduction to the basic skills, vocabulary, and tradition of ballet with concentration on control and proper alignment. No previous ballet experience required. Offered on a satisfactory-fail grading basis only.

Dance 140. Jazz I. (0-3) Cr. 1. F.S. Introduction to the modern jazz style with concentration on isolation and syncopation. No previous jazz experience required. Offered on a satisfactory-fail grading basis only.

Dance 150. Tap Dance I. (0-3) Cr. 1. Instruction and practice in basic tap technique and terminology. No previous tap experience required. Offered on a satisfactory-fail grading basis only.

Dance 160. Ballroom Dance I. (0-2) Cr. 1. F.S. Instruction and practice in foxtrot, waltz, swing, cha cha, rumba, tango, and selected contemporary dances. Offered on a satisfactory-fail grading basis only.

Dance 170. Folk and Square Dance. (0-2) Cr. 1. F.S. Instruction and practice in various international folk dances and American square dance. Offered on a satisfactory-fail grading basis only.

Dance 199. Dance Continuum. Cr. 0.5 to 2 each time taken, maximum of 6 credits. F.S. *Prereq:* *Permission of instructor.* Advance registration required. Continued instruction and practice in either modern dance, recreational dance, ballet, jazz and/or compositional skills. Offered on a satisfactory-fail grading basis only.

Dance 210. Aspects of Rhythmic Movement and Dance. (0-3) Cr. 1. F. *Prereq:* *Exercise and sport science majors or by permission of instructor.* Survey and practice of the relation of rhythm to movement activities and basic dance concepts. Emphasis on methods of teaching rhythm.

Dance 211. Fundamentals of Folk, Square, and Social Dance. (0-3) Cr. 1. S. Skill enhancement, progressions with emphasis on world dance. Designed for exercise and sport science majors, open to others.

Dance 220. Modern Dance Composition. (1-3) Cr. 2. S. *Prereq:* 120 *or previous modern dance experience.* Theory and practice of the creative skills involved in solo and small group composition.

Dance 222. Modern Dance II. (0-3) Cr. 1. F.S. *Prereq:* 120 *or previous modern dance experience.* Dance techniques emphasizing strength, balance, endurance, rhythmic activity and extended combinations. Materials fee.

Dance 223. Modern Dance III. (0-3) Cr. 1. F.S. *Prereq:* 222. Continued experience in dance techniques and extended combinations. Emphasis on maturation of skill and artistry. Exposure to a variety of modern dance technical styles. Materials fee.

Dance 224. Concert and Theatre Dance. (Same as Thre 224.) (0-3) Cr. 0.5 to 2, maximum of 6 credits. F.S. *Prereq:* *By audition only.* Choreography, rehearsal, and performance in campus dance concerts and/or musical theatre productions. Offered on a satisfactory-fail grading basis only.

Dance 232. Ballet II. (0-3) Cr. 1. F.S. *Prereq:* *Previous ballet experience.* Technical skills in the classical movement vocabulary. Emphasis on alignment, techniques, sequence development, and performing quality.

Dance 233. Ballet III. (0-3) Cr. 1. *Prereq:* 232. Concentration on technical proficiency at the intermediate level. Pointe work and partnering opportunities available.

Dance 242. Jazz II. (0-3) Cr. 1. *Prereq:* *Previous jazz dance experience.* Dance concepts within the jazz idiom. Instruction in extended movement sequences and artistic interpretation.

Dance 243. Jazz III. (0-3) Cr. 1. *Prereq:* 242. Integration of the concepts of jazz dynamics, phrasing, and skills into performance situations. Some repertory work of historical and contemporary pieces.

Dance 262. Ballroom Dance II. (0-2) Cr. 1. *Prereq:* *Previous ballroom dance experience.* Practice in ballroom dance routines. Emphasis on style, posture,

and footwork. Defining technique and execution. Leading and following more defined.

Dance 270. Dance Appreciation. (2-0) Cr. 2. F.S. Introduction to dance as an art form, emphasizing abilities to analyze and appreciate various dance styles. No dance experience required.

Dance 320. Sound and Movement. (2-2) Cr. 3. Alt. S., offered 2001. *Prereq:* 220. Intermediate composition based on the relationship of movement to improvised sounds, rhythmic scores, and the musical works of composers from various periods.

Dance 360. History and Philosophy of Dance. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 270. Study of the history of dance from early to modern times with emphasis on the theories and philosophies of contemporary modern dance, dancers, and dance educators.

Dance 370. Advanced Studies in Dance. Cr. 1 to 3 in any one semester to a maximum of 8 credits. F.S. *Prereq:* 2 *credits in dance.* Advance registration required. Designed to meet special interests and talents of students to include both group and independent study in various aspects of dance as a performing art including production, choreography, and performance.

Dance 384. Teaching Children's Dance. (1-3) Cr. 2. S. *Prereq:* 210, *EX SP 275.* Content, experiences, and methods of a comprehensive dance program at the elementary school level. Theories and practice in guiding elementary school children in expressive movement experiences.

Dance 385. Methods of Teaching Dance. (1-3) Cr. 2. F. *Prereq:* 210, 211. Methods and techniques of teaching recreational dance forms. Introduction to teaching educational modern dance.

Dance 386. Teaching Dance Technique and Composition. (1-3) Cr. 2. Alt. F., offered 1999. *Prereq:* 320. Teaching of dance as an expressive art form with emphasis on technique, rhythm, and the creative teaching process.

Dance 490. Independent Study. Cr. 1 to 6, maximum of 6. *Prereq:* 6 *credits in dance and permission of coordinator.* Independent study of problems or areas of interest in dance.

Physical Education (P E)

P E 101. Swimming I. (0-3) Cr. 1. F.S. Basic course for nonswimmers. Emphasis on two fundamental strokes and personal water safety skills. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 102. Swimming II. (0-3) Cr. 1. F.S. *Prereq:* 101 *or equivalent skill.* Intermediate course. Emphasis on learning and improving five basic strokes and personal water safety skills. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 103. Swimming III. (0-3) Cr. 1. F.S. *Prereq:* 102 *or equivalent skill.* Advanced course. Emphasis on ten swimming strokes and personal water safety skills. Improved efficiency on each stroke. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 108. Aquatic Fitness. (0-3) Cr. 1. *Prereq:* 102 *or equivalent skill.* Water related exercises, activities, and swimming workouts to improve physical fitness. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 109. Basic Skin and Scuba Diving. (1-3) Cr. 2. F.S. *Prereq:* *Swimming competence.* Materials fee. Offered on a satisfactory-fail grading basis only.

P E 113. Scuba Assistant Instructor Practicum. (0-2) Cr. 1. *Prereq:* 109 *and permission of instructor.* Supervised experience in conduct of basic scuba diving program. Offered on a satisfactory-fail grading basis only.

P E 114. Lifeguard Training. (0-3) Cr. 1. F.S. *Prereq:* *Ability to swim 500 yards continuously of front crawl, sidestroke, and breaststroke; perform a standing and surface dive; swim under water; and tread water for one minute. Minimum age 16.* Specific training for Red Cross Lifeguard certification. First aid and CPR included. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 115. WSI and Lifeguard Training Instructor. (0-5) Cr. 2. F.S. *Prereq:* Minimum age 17; *c ient lifeguard, first aid, and CPR certifications.* Stroke analysis and methods of class organization and instruction of swimming, water safety, and rescue skills. Red Cross Water Safety Instructor and Lifeguarding Instructor certifications. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 116. Water Safety Instructor Practicum. (0-3) Cr. 1. *Prereq:* 115, *H S 105, CPR certification, and permission of instructor.* Supervised teaching experience in swimming, aquatic fitness, lifeguard training, and WSI courses. Offered on a satisfactory-fail grading basis only.

P E 119. Archery I. (0-2) Cr. 1. F.S. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 122. Badminton I. (0-2) Cr. 1. F.S. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 123. Badminton II. (0-2) Cr. 1. F.S. *Prereq:* 122. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 126. Pocket Billiards I. (0-2) Cr. 1. F.S. Introduction to the basic strokes (stop, draw, follow) and contemporary game forms associated with pocket billiards. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 127. Pocket Billiards II. (0-2) Cr. 1. F.S. *Prereq:* 126. Use of basic strokes in more advanced game forms. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 129. Bowling I. (0-2) Cr. 1. F.S. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 130. Bowling II. (0-2) Cr. 1. F.S. *Prereq:* 129. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 132. Fencing. (0-2) Cr. 1. F.S. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 135. Golf I. (0-2) Cr. 1. F.S. Beginning skills only. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 136. Golf II. (0-2) Cr. 1. F.S. *Prereq:* 135 *or equivalent skill.* Materials fee. Offered on a satisfactory-fail grading basis only.

P E 137. Golf III. (0-2) Cr. 1. F.S. *Prereq:* 136. Emphasis on individual error correction and practice in the advanced skills of golf. Study of comprehensive rules which apply to competitive play. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 139. Gymnastics I. (0-2) Cr. 1. F.S. Offered on a satisfactory-fail grading basis only.

P E 140. Gymnastics II. (0-2) Cr. 1. F.S. *Prereq:* 139 *or equivalent skill.* Offered on a satisfactory-fail grading basis only.

P E 144. Racquetball I. (0-2) Cr. 1. F.S. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 145. Racquetball II. (0-2) Cr. 1. F.S. *Prereq:* 144 *or equivalent skill.* Materials fee. Offered on a satisfactory-fail grading basis only.

P E 151. Cross Country Skiing. (0-2) Cr. 1. S. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 153. Ice Skating. (0-2) Cr. 1. S. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 158. Tennis I. (0-2) Cr. 1. F.S.SS. Introduction to basic skills (forehand, backhand, service) and basic knowledge of game play. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 159. Tennis II. (0-2) Cr. 1. F.S.SS. *Prereq:* 158. Expansion of basic skills to include volley and spins. Introduction to basic strategy. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 160. Tennis III. (0-2) Cr. 1. F.S. *Prereq:* 159. Introduction to more advanced skills (lob, overhead, and spin serves). Materials fee. Offered on a satisfactory-fail grading basis only.

P E 161. Tennis IV. (0-2) Cr. 1. F.S. *Prereq:* 160. Instruction and practice in the more advanced skills of tennis. Emphasis on the use of these skills and

strategy employed in effective singles and doubles play. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 163. Physical Fitness. (0-3) Cr. 1. F.S. Evaluation of fitness status. Exercises, activities, and programs to improve physical fitness. Relationship between physical activity and weight control. Offered on a satisfactory-fail grading basis only. Credit for only 163 or Ex Sp 258 may be applied toward graduation.

P E 164. Walking for Fitness. (0-3) Cr. 1. F.S. Fitness walking as an activity to improve health and fitness; values of this type of activity as a lifetime endeavor. Offered on a satisfactory-fail grading basis only.

P E 165. Aerobics. (0-3) Cr. 1. Exercise class designed to improve fitness; incorporating exercise to music along with various dance styles. Offered on a satisfactory-fail grading basis only.

P E 166. Weight Training I. (0-3) Cr. 1. F.S. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 167. Weight Training II. (0-3) Cr. 1. F.S. *Prereq:* 166. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 168. Judo I. (0-2) Cr. 1. F.S. Offered on a satisfactory-fail grading basis only.

P E 169. Judo II. (0-2) Cr. 1. F.S. *Prereq:* 168. Offered on a satisfactory-fail grading basis only.

P E 170. Tae Kwon Do/Karate I. (0-2) Cr. 1. F.S. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 171. Tae Kwon Do/Karate II. (0-2) Cr. 1. *Prereq:* 170. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 173. Hap Ki Do/Martial Self-Defense. (0-2) Cr. 1. F.S. Offered on a satisfactory-fail grading basis only.

P E 174. Wrestling. (0-2) Cr. 1. F. Offered on a satisfactory-fail grading basis only.

P E 178. Basketball. (0-2) Cr. 1. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 179. Flag Football. (0-2) Cr. 1. F.S. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 180. Softball I. (0-2) Cr. 1. F.S. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 182. Volleyball I. (0-2) Cr. 1. F.S. Materials fee. Offered on a satisfactory-fail grading basis only.

P E 183. Volleyball II. (0-2) Cr. 1. S. *Prereq:* 182 *or equivalent skill.* Materials fee. Offered on a satisfactory-fail grading basis only.

P E 185. Soccer. (0-2) Cr. 1. F. Materials fee. Offered on a satisfactory-fail grading basis only.

Exercise and Sport Science (Ex Sp)

Ex Sp 201. Techniques of Baseball. (0-3) Cr. 1. Fundamentals of pitching, catching, batting, baserunning, infield and outfield play. Designed for the student seeking the coaching endorsement.

Ex Sp 202. Techniques of Basketball. (0-3) Cr. 1. Fundamentals of basket shooting, passing, ball handling, and footwork. Various defensive and offensive patterns. Designed for the student seeking the coaching endorsement.

Ex Sp 203. Techniques of Football. (0-3) Cr. 1. Fundamentals of offensive and defensive line and backfield play; forward passing and kicking skills. Designed for the student seeking the coaching endorsement.

Ex Sp 209. Techniques of Track and Field. (0-3) Cr. 1. Fundamentals of various track and field events included in most high school programs. Designed for the student seeking the coaching endorsement.

Ex Sp 220. Basic Athletic Training. (1-2) Cr. 2. *Prereq:* Zool 155. Introduction to methods of prevention and immediate care of athletic injuries. Basic information concerning health supervision of athletes, and some basic wrapping and strapping techniques for common injuries. Materials fee.

Ex Sp 221. Athletic Training Practicum. (0-3) Cr. 1. *Prereq:* Credit or enrollment in 220 and permission of instructor or program director. Training room experience to accompany 220. Open to students in the athletic training option. Offered on a satisfactory-fail grading basis only.

Ex Sp 224. Evaluation of Athletic Injuries I. (2-3) Cr. 3. F. *Prereq:* 220, permission of instructor or program director. Sport injury assessment procedures and evaluation techniques for lower body injuries. Includes an overview of mechanisms of injury, general musculoskeletal disorders, and dermatological conditions. Designed for students in the athletic training option or preprofessional health programs.

Ex Sp 225. Athletic Training Practicum. (0-3) Cr. 1. *Prereq:* Credit or enrollment in 224 and permission of instructor or program director. Training room experience to accompany 224. Open to students in the athletic training option. Offered on a satisfactory-fail grading basis only.

Ex Sp 226. Evaluation of Athletic Injuries II. (2-3) Cr. 3. *Prereq:* 220, 224, permission of instructor or program director. Sport injury assessment procedures and evaluation techniques for upper body injuries. Includes an overview of common illnesses of athletes and sport specific injuries. Designed for students in the athletic training option or preprofessional health programs.

Ex Sp 227. Athletic Training Practicum. (0-3) Cr. 1. *Prereq:* Credit or enrollment in 226 and permission of instructor or program director. Training room experience to accompany 226. Open to students in the athletic training option. Offered on a satisfactory-fail grading basis only.

Ex Sp 228. Exercise and Nutrition for Lifetime Wellness. (Same as FS HN 228.) (3-0) Cr. 3. F.S. Principles of exercise and nutrition that provide a basis of information for life-long wellness. Open to nonmajors only.

Ex Sp 230. Fundamentals of Aquatics. (0-3) Cr. 1. S. *Prereq:* 101 or equivalent skill. Open to physical education teacher licensure students only. Basic water safety and emergency water safety. Skill enhancement, understanding, and progressions. Materials fee.

Ex Sp 231. Fundamentals of Tumbling and Gymnastics Skills. (0-3) Cr. 1. F. *Prereq:* Open to physical education teacher licensure students only. Fundamentals of tumbling and apparatus, including teaching techniques and safety for the K-12 student. Skill enhancement, understanding, and progressions.

Ex Sp 232. Fundamentals of Soccer, Speedball, and Volleyball. (0-3) Cr. 1. S. *Prereq:* Open to physical education teacher licensure students only. Skill enhancement, understanding, and progressions. Materials fee.

Ex Sp 233. Fundamentals of Softball and Basketball. (0-3) Cr. 1. F. *Prereq:* Open to physical education teacher licensure students only. Skill enhancement, understanding, and progressions. Materials fee.

Ex Sp 234. Fundamentals of Flag Football and Recreational Games. (0-3) Cr. 1. F. *Prereq:* Open to physical education teacher licensure students only. Fundamentals of flag football, floor hockey, recreational and cooperative games. Skill enhancement, understanding, and progressions. Materials fee.

Ex Sp 235. Fundamentals of Tennis and Badminton. (0-3) Cr. 1. S. *Prereq:* Open to physical education teacher licensure students only. Skill enhancement, understanding, and progressions. Materials fee.

Ex Sp 236. Fundamentals of Golf, Archery, and Bowling. (0-3) Cr. 1. F. *Prereq:* Open to physical education teacher licensure students only. Skill enhancement, understanding, and progressions. Materials fee.

Ex Sp 237. Fundamentals of Track and Field and Self-Defense. (0-3) Cr. 1. S. *Prereq:* Open to physical education teacher licensure students only. Skill enhancement, understanding, and progressions.

Ex Sp 250. Health and Human Performance Orientation. (Same as H S 250.) (1-0) Cr. R. F.S. Orientation to various aspects of health and human performance and assistance in learning how to use facilities of the university and department. Offered on a satisfactory-fail grading basis only.

Ex Sp 258. Physical Fitness and Conditioning. (1-3) Cr. 2. F.S. *Prereq: Exercise and sport science or Ch E majors only.* Development of personal fitness using a variety of conditioning and exercise techniques such as aerobics, weight training, and aquatic fitness. Introduction to acute and chronic responses to exercise, and the role of exercise in health promotion and weight management. Credit for only one of the following courses may be applied toward graduation: P E 163, Ex Sp 258.

Ex Sp 259. Leadership Techniques for Fitness Programs. (1-3) Cr. 2. F.S. *Prereq: 258.* Development of exercise leadership skills for a variety of activities. Includes planning, promotion, and teaching techniques for developing fitness in others using a variety of exercise modalities including aerobics, weight training, and aquatic fitness.

Ex Sp 260. History of Sport and Physical Activity. (3-0) Cr. 3. F.S. Development of sport and physical activity in the United States and selected other societies.

Ex Sp 275. Movement Education in Elementary School Physical Education. (2-2) Cr. 3. F. *Prereq: HD FS 226.* Study of movement experiences appropriate for the primary and intermediate grade child. Focuses upon activities that develop physical and motor fitness and awareness of the self in relation to the environment and others. Designed for K-12 physical education licensure students. Credit for only one in the following courses may be applied toward graduation: 275, 284.

Ex Sp 280. Directed Field Experience in Elementary School Physical Education. (0-3) Cr. 1. S. *Prereq: 275.* Observing, planning, and facilitating movement experiences of children in an elementary school setting. Materials fee.

Ex Sp 284. Elementary and Pre-school Movement Education. (2-3) Cr. 3. F.S. *Prereq: 3 credits in human development and family studies.* Approaches to teaching movement skills to pre-school and elementary school age children. Emphasis on planning appropriate learning environments to help children develop perceptual-motor and fundamental movement skills as well as a positive self concept. Practical experience provided through participation in a children's movement education laboratory. Credit for only one in the following courses may be applied toward graduation: 275, 284.

Ex Sp 315. Coaching Theory and Administrative Issues. (2-3) Cr. 3. *Prereq: Beginning-level skills in two of the following sports (baseball, basketball, football, golf, soccer, softball, swimming, tennis, track & field, volleyball).* Study in the theory, strategy, and mechanics of coaching various interscholastic and/or intercollegiate sports. Emphasis on formulating a philosophy, identifying goals and psychological aspects, teaching skills, and developing strategies. Practical experience provided.

Ex Sp 323. Therapeutic Modalities for Athletic Trainers. (1-2) Cr. 2. F. *Prereq: 224, 226, permission of instructor.* Theory and technique of athletic modalities used in the management of athletic injuries.

Ex Sp 326. Rehabilitation of Athletic Injuries. (1-2) Cr. 3. S. *Prereq: 224, 226, 323.* Theory and practical application of rehabilitation principles used in the management of athletic injuries.

Ex Sp 327. Athletic Training Practicum. (0-3) Cr. 1. *Prereq: Credit or enrollment in 326 and permission of instructor or program director.* Training room experience to accompany 326. Open to students in the athletic training option. Offered on a satisfactory-fail grading basis only.

Ex Sp 340. Principles of Sport Management. (3-0) Cr. 3. An overview of ethical decision making relative to organizational principles and management in the sport industry and the development, implementation and evaluation of strategic plans for sport organizations. Topics include fundamentals of leadership the-

ory, human resources, organizational communication, financial planning and law.

Ex Sp 350. Sport Marketing. (3-0) Cr. 3. *Prereq: 340, Mkt 340.* Application of fundamental marketing concepts to the sport industry, including marketing strategies/research, information management, identification of target markets, and the segmentation process. Topics include sport consumer behavior, corporate sponsorship, and promotion and public relations in sport.

Ex Sp 352. Sport Facility and Event Management. (3-0) Cr. 3. *Prereq: 340.* Factor related to planning, managing and hosting a variety of events including major tournaments, intramural and intercollegiate competitions, and community recreational activities. Examination of topics associated with sport facility operation to include financing new facilities, generating capital and conducting feasibility studies.

Ex Sp 355. Biomechanics. (3-3) Cr. 4. F.S. *Prereq: Zool 155, 156, Phys 106 or 111.* The study of anatomical and mechanical phenomena which underlie human motion. Includes the application of biomechanical concepts to a wide variety of exercise, fundamental movement, sport, and physical activities. Nonmajor graduate credit.

Ex Sp 356. Biomechanical Aspects of Human Movement. (3-0) Cr. 3. F. *Prereq: Zool 155.* The study of anatomical and mechanical bases of human motion with application to sport and fundamental movement skills.

Ex Sp 360. Sociology of Sport and Physical Activity. (3-0) Cr. 3. F.S. *Prereq: Soc 134.* Sport as a social system and as an institution related to other institutions such as the polity, the economy, the mass media, and education.

Ex Sp 365. Psychology of Sport and Physical Activity. (3-0) Cr. 3. F.S. *Prereq: Psych 101.* Psychological factors that influence performance in a movement setting. Analysis of the role of motivation and stress remediation techniques in relation to sport and physical activity.

Ex Sp 372. Motor Learning and Control. (2-2) Cr. 3. F.S. *Prereq: Psych 101.* Emphasis on the learning and control of skilled movement.

Ex Sp 375. Teaching Physical Education. (2-3) Cr. 3. S. *Prereq: 372, credit or enrollment in C I 201, admission to College Teacher Education Program.* Principles and current practices of teaching physical education. Required practicum to be arranged.

Ex Sp 395. Adapted Physical Education. (Dual-listed with 595.) (2-3) Cr. 3. F. *Prereq: 375.* Specific disabling conditions in terms of etiology, characteristics, needs, and potential for movement experiences. Techniques of assessment, prescription, adaptation of activities, methods, and program planning. Laboratory experience required.

Ex Sp 401. Job Search Skills and Strategies. (Same as H S 401.) (1-0) Cr. R. F.S. *Prereq: Senior classification.* Job search techniques and preparation of related materials. Resources specifically related to employment in health and human performance fields. Offered on satisfactory-fail grading basis only.

Ex Sp 417. Supervised Teaching in Physical Education in the Secondary School. Cr. var. F.S. *Prereq: 355 or 356, 395, 470, 455 or 456, 475.* Supervised teaching in the secondary schools. Advance registration required.

Ex Sp 418. Supervised Teaching in Physical Education in the Elementary School. Cr. var. F.S. *Prereq: Ex Sp 280, Dance 384.* Supervised teaching in the elementary schools. Advance registration required.

Ex Sp 425. Organization and Administration of Athletic Training. (2-0) Cr. 2. F. *Prereq: 323, senior classification.* Current administrative, professional, and legal issues pertaining to athletic training.

Ex Sp 435. Sport Business and Finance. (3-0) Cr. 3. *Prereq: Ex Sp 340, 3 cr. of Math, Stat 101, Acct 284.* An introduction to financial management and budgeting in sport organizations with an emphasis on forecasting, taxation, investing, accounting, revenue generation and allocation, and economic impact studies.

Ex Sp 440. Health Promotion in the Community and Workplace. (2-2) Cr. 3. *Prereq: 258, FS HN 167, Psych 101.* Survey of health promotion programs in community and workplace settings. Organization, implementation, and administration of wellness programs such as weight loss, smoking cessation, cholesterol reduction, and stress management.

Ex Sp 445. Legal Aspects of Sport. (3-0) Cr. 3. A presentation of the basic legal system, its terminology, and principles as applied to professional and amateur sports. Emphasis is on identifying and analyzing legal issues in sport, the ramifications of those issues in contemporary society with special attention to contract, tort and constitutional law. Designed for coaches, athletic directors and other sport management professionals.

Ex Sp 455. Physiology of Exercise. (3-3) Cr. 4. F.S. *Prereq: 258, Zool 156.* Physiological basis of human performance; effects of physical activity on body functions. Nonmajor graduate credit.

Ex Sp 456. Physiological Aspects of Human Movement. (3-0) Cr. 3. S. *Prereq: Zool 155.* An overview of physiological and metabolic responses to acute and chronic exercise with an emphasis on improving and maintaining human performance.

Ex Sp 458. Principles of Fitness Assessment and Exercise Prescription. (2-3) Cr. 3. *Prereq: 258, 455.* Physiological principles of physical fitness; design and administration of fitness programs; testing, evaluation, and prescription; cardiac risk factor modification.

Ex Sp 459. Internship in Exercise Leadership. (0-3) Cr. 1. *Prereq: C- or better in 259, CPR certification, concurrent enrollment in 458.*

Ex Sp 462. Medical Aspects of Exercise. (2-0) Cr. 2. *Prereq: 455.* The role of exercise in preventive medicine. Impact of exercise on various diseases, and the effect of various medical conditions on the ability to participate in vigorous exercise and competitive sports. Principles of exercise testing and prescription for individuals with these conditions.

Ex Sp 465. Physical Activity and Aging. (2-0) Cr. 2. *Prereq: Psych 230, Zool 155.* The effect upon movement of physical changes occurring in healthy aging as well as chronic conditions associated with aging. Methods of assessing fitness and teaching movement activities in relation to gerontological factors. Nonmajor graduate credit.

Ex Sp 470. Evaluation in Physical Education. (2-3) Cr. 3. S. *Prereq: Senior classification.* Principles underlying process of evaluation. Selected test and measurement procedures and tools within the field of physical education.

Ex Sp 475. Physical Education Curriculum Design and Program Organization. (3-0) Cr. 3. F. *Prereq: 375.* Current practices and principles applied to curriculum development and to problems of organization and administration of instructional and extracurricular programs in physical education. Nonmajor graduate credit.

Ex Sp 485. Internship in Sport and Exercise Science. Cr. 8-16. *Prereq: Senior classification and advance registration.* Observation and practice in selected sport and exercise science agencies. Offered on a satisfactory-fail grading basis only.

A. Exercise Science. *Prereq: C- or better in 458 and 459, exercise and sport science majors only.*

B. Sport and Physical Activity. *Prereq: Exercise and sport science majors only.*

C. Sport Management. *Completion of the Sport Management core classes (Ex Sp 350, 352, 435, & 445) with no less than a C- in each course.*

Ex Sp 486. Supervised Coaching in Interscholastic Athletics. Cr. 1 to 3. *Prereq: 220, 315, 355 or 356, 365, 455 or 456; Psych 230: senior classification, admission to teacher education program, and permission of instructor.* Advance registration required. Open only to students in the coaching endorsement program. Offered on a satisfactory-fail grading basis only.

Ex Sp 488. Practicum in Athletic Training. Cr. 1 to 2, maximum of 4. *Prereq: Permission of instructor.* Experience in application of athletic training tech-

niques under supervision of certified athletic trainers. Offered on a satisfactory-fail grading basis only.

Ex Sp 490. Independent Study. Cr. 1-3, maximum of 6. *Prereq:* 6 credits in exercise and sport science and permission of coordinator. Independent study of problems of areas of interest in exercise and sport science and related areas.

- A. Exercise and Sport Science
- B. Coaching
- H. Honors

Ex Sp 495. Seminar in Exercise and Sport Science. Cr. 0.5 to 1. *Prereq:* Senior classification. Offered on a satisfactory-fail grading basis only.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Ex Sp 500. Research Methods in Exercise and Sport Science. (3-0) Cr. 3. *Prereq:* Graduate classification in exercise and sport science. Methods and techniques used in the design and interpretation of research in exercise and sport science. Emphasis on styles of writing, library use, and computer applications.

Ex Sp 505. Research Laboratory Techniques in Exercise Physiology. (0-4) Cr. 2. *Prereq:* 455 or equivalent course with basic laboratory experience. Application and use of laboratory research equipment in exercise physiology, including operation, calibration, and use in selected situations.

Ex Sp 510. Advanced Medical Aspects of Exercise. (2-0) Cr. 2. *Prereq:* 455. The role of exercise in preventive medicine. Impact of exercise on various diseases, and the effect of various medical conditions on the ability to participate in vigorous exercise and competitive sports. Principles of exercise testing and prescription for individuals with these conditions.

Ex Sp 515. Qualitative Analysis of Human Movement. (2-3) Cr. 3. *Prereq:* 355. The kinematic analysis of developmental movement tasks and sport skills.

Ex Sp 516. Quantitative Analysis of Human Movement. (3-1) Cr. 3. *Prereq:* 355 or 356. Application of the principles of mechanics to the analysis of human motion. Investigation of the effects of kinematics and kinetics on the human body with special emphasis on exercise and sport applications. Includes consideration of two-dimensional and three-dimensional imaging techniques and force measurements.

Ex Sp 520. The Social Analysis of Sport. (3-0) Cr. 3. *Prereq:* 360, Soc 134. Sociological analysis of sport with emphasis on sociological theory, sports structure, and function in modern industrialized society; the systems of sport in regard to their role structure; formal organization, and professionalization and its differentiation along social class, age, and sex.

Ex Sp 521. Sport Psychology. (3-0) Cr. 3. *Prereq:* 365, 3 courses in psychology. Aspects of psychology which form a basis for understanding and explaining behavior in a sport context. Variables underlying individual as well as group performance will be analyzed. A critical analysis of current research literature.

Ex Sp 522. Social-Psychological Perspectives of Sport and Motor Performance. (3-0) Cr. 3. *Prereq:* 360. Analysis of social-psychological dimensions that modify and facilitate motor behavior; focuses on the individual and small group behavior in the sports context.

Ex Sp 523. Gender Roles and Sport. (Same as W S 523.) (3-0) Cr. 3. *Prereq:* 360, 3 courses in sociology and/or psychology. Analysis of the influence of sport on male and female sex role development. Survey of literature related to sport and sex role socialization, stereotyping, and conflict. Discussion of future issues and alternative roles.

Ex Sp 530. Comparative Physical Education and Sport. (3-0) Cr. 3. *Prereq:* 260. A comparative analysis of dominant characteristics and developments in physical education and sport in selected countries.

Ex Sp 540. Administration of Sport Programs. (3-0) Cr. 3. *Prereq:* 340. Theory and practice of administration in physical education and sport; development

of concepts related to the process of administration, types of administrative behavior, tasks and responsibilities of the administrator; evaluation of effectiveness of administration.

Ex Sp 541. Sport Marketing and Promotion. (3-0) Cr. 3. *Prereq:* 350 or Mkt 340; Stat 401. Marketing of sport as a product and marketing of non sport-related products through sport. Includes market definition, consumer analysis, market research, market segmentation, product positioning, pricing, promotion, marketing communication, distribution, and sponsorship applied to sport.

Ex Sp 542. Sport Business. (3-0) Cr. 3. *Prereq:* 435 and Acct 215 or 284. Analysis of theoretical and applied principles of economics, finance, accounting, and budgeting related to sport.

Ex Sp 545. Sports Law. (3-0) Cr. 3. *Prereq:* 402 or 475 or Acct 215. Analysis of the legal aspects of sport and athletics in contemporary society. Includes use of the case study approach. Designed for coaches, athletic directors, and others involved in sport management.

Ex Sp 550. Advanced Physiology of Exercise I. (2-3) Cr. 3. *Prereq:* 505. Concepts and methods of assessing neurological, muscular, cardiovascular, and respiratory adjustments to exercise.

Ex Sp 551. Advanced Physiology of Exercise II. (2-3) Cr. 3. *Prereq:* 505. Analysis of factors affecting work capacity and performance. Human energy metabolism concepts and measurement.

Ex Sp 558. Physical Fitness—Principles, Programs and Evaluation. (Dual-listed with 458.) (2-3) Cr. 3. *Prereq:* 455. Physiological principles of physical fitness, design and administration of fitness programs; testing, evaluation, and prescription; cardiac rehabilitation programs.

Ex Sp 560. Perceptual Motor Learning. (2-3) Cr. 3. *Prereq:* 372. Emphasis on theories of perceptual motor learning characteristics of the learner and the learning environment with implications for the design of learning settings and further research.

Ex Sp 561. Movement, Motor Ability, and Motor Performance of Children. (2-0) Cr. 2 to 3. *Prereq:* 284, Psych 230. The physical development and characteristic reactions of children in relation to motor performance. Identification of special psychomotor needs of various age groups of children. All literature and theories applied to the physical education environment.

Ex Sp 590. Special Topics. Cr. 1 to 3.
A. Physical Education
B. Health Studies
C. Sport Management
D. Exercise Physiology
E. Sport Sociology
F. Sport Psychology
G. Motor Learning
H. Biomechanics

Ex Sp 591. Supervised Field Experience. Cr. 1 to 4. *Prereq:* 10 graduate credits in exercise and sport science and/or related areas. Supervised on-the-job field experience in special areas.

- A. Physical Education
- C. Sport Management
- D. Exercise Physiology

Ex Sp 593. Workshops. Cr. 1 to 3.

Ex Sp 595. Adapted Physical Education. (Dual-listed with 395.) (2-3) Cr. 3. *F. Prereq:* 375. Specific disabling conditions in terms of etiology, characteristics, needs, and potential for movement experiences. Techniques of assessment, prescription, adaptation of activities, methods, and program planning. Laboratory experience required. May not be taken by students who have previously earned credit in 393.

Ex Sp 599. Creative Component. Cr. 1 to 3.

Courses for Graduate Students

Ex Sp 615. Seminar. Cr. 1 to 3.

Ex Sp 699. Research. Cr. 1-6.

History

George T. McJimsey, Chair of Department
University Professors: Schwieder

Professors: Apt, Bennett, Cravens, Dobson, Hurt, Keller, Kottman, Marcus, McJimsey, Plakans, Ruebel, Wilson

Professors (Adjunct): Dobbs

Professors (Emeritus): Geiger, Lowitt, Rawson, Schofield, Wilt

Associate Professors: Avraamides, McCarthy, Pope

Associate Professors (Emeritus): Whitaker

Assistant Professors: Andrews, Bix, Labode, Madison, Osborn, Taylor

The department offers a variety of survey courses (200 series, basically for first- and second-year students) designed to serve as either general education courses or as introductions to advanced courses in history or other subject areas. The department also offers curricula leading to the B.A. and B.S. degrees in history, the M.A. degree in history, the M.A. and Ph.D. degrees in the history of technology and science, and the Ph.D. degree in agricultural history and rural studies.

In addition to the survey (200-level) courses, advanced undergraduate courses are offered in the history of Europe, Asia, Latin America, the United States, technology and science, agriculture, and of some selected topics.

Undergraduate Study

The History major. For a description of the undergraduate curriculum with a major in History see *Liberal Arts and Sciences, Curriculum*. The History major may earn either a bachelor of arts or bachelor of science degree. Candidates for the B.A. must complete two years of university-level study in one foreign language or the equivalent. The minimum required for a major in history is 30 credits, of which at least 24 must be in courses numbered 300 or above. A minimum of 12 credits numbered 300 or above must be taken in residence at Iowa State. All History majors must complete two enrollments in Hist 495 (for R credit) or, if qualified and willing, one graduate-level writing/research seminar. The history major prepares a student with the ability to write and think clearly and to understand the nature of social organization. It specifically prepares the student to think chronologically, to understand past events in their relation to the present, to carry out research with a variety of sources, and to analyze and interpret past and present events. History majors who choose minors in other departments usually select from such complementary disciplines as Political Science, English, Sociology, Psychology, Economics, Philosophy, or Foreign Languages and Literatures.

English proficiency requirement: History majors must receive a grade of C or better in each of Engl 104 and 105 (or 105H), and Hist 495 or any graduate seminar.

For a description of the major in History as preparation for professional programs, see *Teacher Education and Preprofessional Study*. Students majoring in History may also earn a second major in International Studies; see *International Studies*.

Although the department does not require specialization, majors and nonmajors may elect to group their courses in one of several areas of emphasis. The following short list shows the department's undergraduate courses by such areas of emphasis. Qualified undergraduates may also take some 500-level graduate courses, with permission of the instructor (see listing of graduate courses below). Consult the main listing of courses for full description. **Europe:** 201, 202, 304, 305, 325, 326, 401, 402, 403, 404, 405, 406, 408, 410, 411, 412, 414, 417, 419, 420, 421, 422, 424, 426, 430, 431.

Asia, Africa, Latin America: 207, 208, 310, 311, 336, 337, 338, 340, 341, 441.

United States: 221, 222, 307, 351, 352, 353, 354, 370, 450, 451, 454, 455, 457, 458, 459, 462, 463, 464, 465, 467, 469, 470, 471, 472.

Technology and Science: 280, 281, 284, 285, 323, 380, 387, 388, 481, 482, 483, 484, 485, 488, 489.

Agriculture: 365, 366, 460, 461, 476.

Topical Courses: 297, 301, 374, 375, 376, 377, 381, 382, 384, 386, 389, 390, 480, 490, 495.

Courses dealing with the history of technology and science have been structured to offer a sequence leading from basic surveys through courses in the history of particular technologies and sciences. In this area of emphasis, it is recommended that students electing Hist 481, 482, 483, or 485 have taken a basic survey in the history of technology and science (either Hist 280-281 or 284-285) or have taken a college-level course in an appropriate technology or science, or seek permission of the instructor. An undergraduate emphasis in the history of technology and science could include either Hist 281-282 or 284-285 and some combination from Hist 323, 380, 387, 388, 480, 481, 482, 483, 484, 485, 488, and 489.

The department offers a minor in History, which may be earned with 15 credits in History courses, of which at least 9 must be in courses numbered 300 or above. A minimum of 9 credits numbered 300 or above must be taken at Iowa State. The History minor is most frequently chosen by students majoring in Political Science, English, Journalism, Computer Science, and Business.

Graduate Study

Graduate students may take any 400-level history course except 490 and 495 for graduate credit. No more than 12 credits of 400-level courses, however, may be used toward the minimum credits required for a graduate degree in history. Additional work is required for graduate credit in 400-level courses.

Most history graduate courses are either proseminars or seminars. Proseminars acquaint students with the historical literature of a field and prepare them for careers in teaching and research. Seminars require students to conduct original historical research and to write extensive research papers reporting the results.

The M.A. in history. For the M.A. in history, students may elect a thesis or a nonthesis program. History 583C is required of all M.A. students during their first fall semester. See the departmental brochure on the M.A. in History for a full discussion of the options and requirements. A student shall demonstrate proficiency in the use of a research tool such as a foreign language, statistics, computer programming, or the like, as prescribed by his or her advisory committee. The M.A. in history program serves as the basis for continued study in history, law, or business; preparation for teaching in high school or junior college; preparation for government service; or as part of a general education. For international students, a TOEFL score of 600 is required at the time of admission.

The M.A. and Ph.D. in history of technology and science. The graduate program in the history of technology and science examines the role of technology and science in the formation of modern societies and their attitudes toward people and the world. The program is structured in a sequence of courses leading to the M.A. and Ph.D. degrees. Since these courses approach their subject in the context of social and cultural change, they are also open to and appropriate for students in engineering, the sciences, science education, and science journalism. For a thorough description of the program requirements, see the department's brochure on the history of technology and science program.

The Ph.D. in agricultural history and rural studies. The program is designed as a Ph.D. program, but students without an M.A. in history will be expected to qualify for the departmental M.A. in history while progressing toward the doctorate. In some cases, the M.A. may be recommended as the terminal degree. Thirty semester hours of graduate credit are required for the M.A. and 72 for the Ph.D. Students who continue beyond the M.A. are expected to pass a qualifying examination in their general field of study and preliminary examinations in three areas of specialization, complete a dissertation, and defend it orally in the Ph.D. final examination. See the departmental brochure on the program for a full description of requirements.

The following short list of the department's graduate courses is organized by areas of emphasis; see the main listing for complete descriptions. Courses at the 500 level are taken by graduate students (major or minor) and, occasionally, by qualified undergraduates; those at the 600 level are taken by graduate students (major or minor) only.

Europe: 512 series, 530 series, 594 series.

Asia, Latin America: 510, 513, 592, 595.

United States: 511 series, 572, 593 series.

Technology and Science: 570, 571, 574, 575, 576, 600, 602, 603, 604, 605, 606, 607.

Agriculture and Rural Studies: 550, 552 series, 554 series, 556, 608, 609, 610.

Topical: 514, 580, 583 series, 590, 597, 598.

Courses Primarily for Undergraduate Students

Hist 201. Introduction to Western Civilization I. (3-0) Cr. 3. F. Western civilization from ancient Mediterranean world to 1650. Social and cultural developments; economic and political ideas and institutions; problems of historical change and continuity.

Hist 202. Introduction to Western Civilization II. (3-0) Cr. 3. S. Western civilization from 1650 to present. Social and cultural developments; economic and political ideas and institutions; problems of historical change and continuity.

Hist 207. Chinese Civilization. (3-0) Cr. 3. F. Bennett. Origins, development, decline and transformation of China from earliest times to present.

Hist 208. Japanese Civilization. (3-0) Cr. 3. S. Bennett. Origins, development, and transformation of Japan from earliest times to present.

Hist 221. Survey of United States History I. (3-0) Cr. 3. F. Colonial foundations: revolution, confederation, and constitution; nationalism and democracy; sectional disunity, Civil War, and reunion.

Hist 222. Survey of United States History II. (3-0) Cr. 3. S. Industrialization; emergence as a great power; boom and depression; war, internationalism and Cold War; modern industrial society.

Hist 280. Introduction to History of Science I. (Same as M E 280.) (3-0) Cr. 3. F. Ideas of nature from Babylonia to Renaissance.

Hist 281. Introduction to History of Science II. (Same as M E 281.) (3-0) Cr. 3. S. Science from seventeenth-century scientific revolution to Darwin and Einstein.

Hist 284. Introduction to History of Technology and Engineering I. (Same as M E 284.) (3-0) Cr. 3. F. Technology in various civilizations from Sumer and Egypt to early 18th century Europe.

Hist 285. Introduction to History of Technology and Engineering II. (Same as M E 285.) (3-0) Cr. 3. S. Technology in Western world in nineteenth and twentieth centuries.

Hist 297. History As A Career. (1-0) Cr. 1. F. Introduction to history-related careers in academic and public history.

Hist 301. Historical Perspectives on Peace and War. (3-0) Cr. 3. F. *Prereq:* Sophomore classification. Osborn. Social, economic, political, and ideological dynamics of human conflict that have contributed to the dialectic of peace and war.

Hist 304. Cultural Heritage of the Ancient World. (Same as CI St 304.) (3-0) Cr. 3. F. *Prereq:* Sophomore classification. Avraamides. Historical examination of art, literature, thought, and religious beliefs of major civilizations of ancient Mediterranean countries until the end of the 8th century.

Hist 305. Cultural Heritage of the Modern World. (3-0) Cr. 3. *Prereq:* Sophomore classification. Marcus. Examination of parallel formal and structural elements in scientific and social thinking, technological design, and composition in literature and the arts from the late medieval period to the 20th century.

Hist 307. American Popular Culture. (3-0) Cr. 3. *Prereq:* Sophomore classification. Social practices, beliefs and material traits of everyday life in America from the mid-19th century to the present. Includes literature, music, theater and other entertainments. Dime novels, vaudeville, rock and roll music, Hollywood and establishment of professional athletic leagues are among the cultural artifacts and phenomena considered.

Hist 310. Introduction to African History I. (Same as Af Am 310.) (3-0) Cr. 3. *Prereq:* Sophomore classification.

Courses and Programs History 247

fication. Labode. Provides an overview of cultures and societies of Africa: prehistory to 1700.

Hist 311. Introduction to African History II. (Same as Af Am 311.) (3-0) Cr. 3. *Prereq: Sophomore classification.* Labode. Provides an overview of cultures and societies of Africa, 1700 to present.

Hist 323. Science and Religion. (Same as Relig 323.) (3-0) Cr. 3. *Prereq: Sophomore classification.* Wilson. History of changing interplay of science and religion in our understanding nature, from Platonism to Darwinism.

Hist 325. History of England I. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* England from pre-history to 1688. Growth of political and religious institutions; medieval social, economic, and constitutional development; Tudor and Stuart monarchies; Reformation and civil war.

Hist 326. History of England II. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* England since 1688. Political and social change; constitutional and economic development; Britain as a world power; modern British society.

Hist 336. History of Modern China I. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Bennett. China from 1644 to 1912; internal and external stimuli on traditional structure leading to reform and revolution.

Hist 337. History of Modern China II. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Bennett. China from 1912 to present; search for a new order and continuing Chinese revolution.

Hist 338. Modern Japanese History. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Dobbs. Japan 1600 to present; emphasis on transformation of feudal Japan into a post-industrial society.

Hist 340. History of Latin America I. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Osborn. Colonial Latin America from European discovery and colonization to wars for independence.

Hist 341. History of Latin America II. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Osborn. Modern Latin America national origins from 1800 to present.

Hist 351. Social and Cultural History of American People I. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Cravens. History of ordinary Americans since 1800: development of society; dissemination of popular ideas; living conditions, work, and play; the arts, music, architectural styles, material culture; rural and urban lifestyles; majority-minority and gender relations; religion, mass culture, corporations, and technology in modern times from 1800.

Hist 352. Social and Cultural History of American People II. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Cravens. History of ordinary Americans since 1900: development of society; dissemination of popular ideas; living conditions, work, and play; the arts, music, architectural styles, material culture; rural and urban lifestyles; majority-minority and gender relations; religion, mass culture, corporations, and technology in modern times.

Hist 353. History of African Americans I. (Same as Af Am 353.) (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Pope. African roots of Black culture, slavery, abolition, Civil War, Reconstruction.

Hist 354. History of African Americans II. (Same as Af Am 354.) (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Pope. Institutionalization of segregation, urban migration, Harlem Renaissance, Garvey movement, Depression and world wars, civil rights movement, and Black Power.

Hist 365. History of American Agriculture I. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* American agricultural development from colonial times: European background, colonial period to 1865.

Hist 366. History of American Agriculture II. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* American agricultural development from colonial time, 1865 to present.

Hist 370. History of Iowa. (3-0) Cr. 3. *Prereq: Sophomore classification.* Schwieder. Survey of major social, cultural, and economic developments in Iowa from the late 1700s. Emphasis on minority

groups, pioneer life, early economic development, industrial development, educational and religious development, and outstanding personalities.

Hist 374. Women in Classical Antiquity. (Same as Cl St 374.) See *Classical Studies.*

Hist 375. United States Business History. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Dobson. Development of business structures, institutions, and practices from colonial joint-stock companies to modern conglomerates, including economic, legal, regulatory, and international aspects.

Hist 376. International Business History. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* McCarthy. Comparative approach, based on selected examples from Europe, Africa, Asia, and Latin America, to such topics as entrepreneurship, organization, and controversial roles of business people and groups in creating both development and underdevelopment.

Hist 377. Women and Imperialism. (Same as W S 377.) (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Labode. Explores impact which British imperialism had on indigenous and Western women in nineteenth and twentieth centuries; discusses impact of imperialism on women's roles in religion, politics, education, work, and family.

Hist 380. History of Women in Science, Technology, and Medicine. (Same as W S 380.) (3-0) Cr. 3. *Prereq: Sophomore classification.* Bix. History of women's relationship to the fields of science, technology, and medicine, as students and professionals, consumers, subjects and patients, family members, workers and citizens. Concentrates especially on 19th and 20th century United States, concluding with an examination of current issues of special interest to women in science, technology, and medicine.

Hist 381. International Economic History. (Same as Econ 381.) (3-0) Cr. 3. F. *Prereq: Sophomore classification.* McCarthy. Origins and evolution of European capitalism: varieties of agricultural and industrial transformation in Europe; expansion of Europe and impact on Africa, Caribbean, Latin America, and Asia.

Hist 382. United States Economic History. (Same as Econ 382.) (3-0) Cr. 3. S. *Prereq: Sophomore classification.* McCarthy. Origins and evolution of United States capitalism; importance of varieties of economics; importance of legal structures; growing interdependence of power sectors.

Hist 384. History of the Family in the Western World. (3-0) Cr. 3. *Prereq: Sophomore classification.* Plakans. An exploration of changes in family forms and family life from 1200 to present, American familial experience considered as one example.

Hist 386. History of Women in America. (Same as W S 386.) (3-0) Cr. 3. *Prereq: Sophomore classification.* A survey of social, economic, and political aspects of women's role from colonial era to present; emphasis on employment, education, concepts of sexuality, and changing nature of the home.

Hist 387. Technology, Science, and Society in Modern Europe. (Same as M E 387.) (3-0) Cr. 3. *Prereq: Sophomore classification.* Wilson. From the late eighteenth-century beginnings of industrial revolution in Britain to World War I. Examination of reciprocal influences on scientists, engineers, and society.

Hist 388. History of Physics and Astronomy. (3-0) Cr. 3. *Prereq: Sophomore classification.* Wilson. From the eighteenth-century triumph of Newton's gravitational theory to twentieth-century ideas of an evolving universe. Development of physical ideas and their increasing application to astronomy.

Hist 389. Modern Military History I. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Relationships between war and society in America and Europe from 1750 to 1918.

Hist 390. Modern Military History II. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Warfare during the twentieth century; emphasis on World War II experience.

Hist 401. Ancient Near East. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Avraamides. Political,

socio-economic, artistic, and religious history of ancient Mesopotamia and Egypt.

Hist 402. Ancient Greece. (Same as Cl St 402.) (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Avraamides. Ancient Greece from the Bronze Age to Hellenistic Kingdoms; evolution of Greek polis and its cultural contributions.

Hist 403. Ancient Rome I. (Same as Cl St 403.) (3-0) Cr. 3. *Prereq: Sophomore classification.* Ruebel. Political, social, and institutional history of ancient Rome, and its cultural contributions studied through original sources: Republican Era: Punic Wars to the assassination of Julius Caesar.

Hist 404. Ancient Rome II. (Same as Cl St 404.) (3-0) Cr. 3. *Prereq: Sophomore classification.* Ruebel. Political, social, and institutional history of ancient Rome, and its cultural contributions studied through original sources: Imperial Age: Augustus to the rise of Constantine.

Hist 405. History of Medieval Western Europe I. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Madison. Development of political, economic, and social institutions: Early and Central Middle Ages, 284-1050.

Hist 406. History of Medieval Western Europe II. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Madison. Development of political, economic, and social institutions: High and Late Middle Ages, 1050-1500.

Hist 408. Europe, 1500-1648. (3-0) Cr. 3. *Prereq: Sophomore classification.* Northern Renaissance; Church and Luther; Protestant reform and Roman-Catholic counter-reform; social, cultural, and economic changes; Spain in triumph and decline; religious wars and emergence of France.

Hist 410. 19th Century Europe. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Nationalism, revolution, and war.

Hist 411. Contemporary Europe I. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Europe from 1914 to end of World War II.

Hist 412. Contemporary Europe II. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Europe since 1945 with emphasis on political, economic, and social developments.

Hist 414. European Cultural and Intellectual History. (3-0) Cr. 3. *Prereq: Sophomore classification.* A study of perennial ideas: nature, man, God, society, history and creativity, from Dante to Sartre.

Hist 417. European Society and the Industrial Revolution. (3-0) Cr. 3. *Prereq: Sophomore classification.* Plakans. England and the continent during industrialization (1750-1900), with emphasis on the relationship between industrial and social change.

Hist 419. History of Modern France. (3-0) Cr. 3. *Prereq: Sophomore classification.* From absolutism to revolution and the rise of modern democracy.

Hist 420. History of the Mediterranean. (3-0) Cr. 3. *Prereq: Sophomore classification.* Spain, Italy, and Portugal from Renaissance to present.

Hist 421. History of Russia I. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Andrews. Russia to 1850. Origins of Russian people; Byzantine influences; Mongol invasion; rise of Moscow; Westernization.

Hist 422. History of Russia II. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Andrews. Russia since 1850. Reform and revolution; transformation of society; USSR as a world power; recent changes.

Hist 424. History of Modern Germany. (3-0) Cr. 3. *Prereq: Sophomore classification.* Cultural, economic, and political developments in nineteenth and twentieth century Germany.

Hist 426. Nationalism and Communism in Eastern Europe. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Plakans. A survey of nationalist movements, nation-building, and communist revolutions in Eastern Europe in the nineteenth and twentieth centuries.

Hist 430. Modern England I. (3-0) Cr. 3. *Prereq: Sophomore classification.* England from 1688 to

1850. Political, social, cultural, economic development; England as a great power.

Hist 431. Modern England II. (3-0) Cr. 3. *Prereq: Sophomore classification.* England since 1850. Parliamentary and constitutional development; social reform and economic change; imperial Britain; welfare state.

Hist 441. History of Modern Mexico and Central America. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Osborn. Political, economic, and social development of Mexico and Central America in nineteenth and twentieth centuries.

Hist 450. Colonial America. (3-0) Cr. 3. *Prereq: Sophomore classification.* Keller. Exploration, colonization, and development of political, economic, social, and cultural institutions of North American colonies before 1754.

Hist 451. American Revolution. (3-0) Cr. 3. *Prereq: Sophomore classification.* Keller. Participants, ideas, and events leading to independence and the foundation of the American Republic, 1754 to 1787.

Hist 454. Prologue to the U.S. Civil War. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* McJimsey. Origins of second party system. Social and economic forces that sustained the system and ultimately caused its collapse and sectional division, 1815-1861.

Hist 455. The U.S. Civil War and Reconstruction. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* McJimsey. Emphasis on military and political events of the Civil War and their influence on postwar America, 1861-1877.

Hist 457. The Populist-Progressive Years. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Dobson. United States' transition from an agrarian society to a mature industrial giant, emphasizing political, economic, and social developments of late 19th and early 20th centuries.

Hist 458. U.S. World War I to 1945. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Kottman. America in crisis: World War I, the twenties, depression, and World War II.

Hist 459. U.S. 1945-1969. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Kottman. Liberal ascendancy and Cold War: Fair Deal, modern republicanism, the Great Society, an assertive America, culminating in Vietnam.

Hist 460. The Great Plains. (3-0) Cr. 3. *Prereq: Sophomore classification.* Hurt. History of the Great Plains from prehistoric period. Emphasis on agricultural and rural development. Native Americans, cattle ranching, land policy, agrarian reform movements, and federal policy.

Hist 461. The Rural South. (3-0) Cr. 3. *Prereq: Sophomore classification.* Hurt. Agricultural and rural history of the South from colonial period to present. Emphasis on economic, social, and political change. Slavery, Populism, New Deal, and civil rights movement.

Hist 462. History of American Thought I. (3-0) Cr. 3. *Prereq: Sophomore classification.* Cravens. American religious, social, and political thought; development of democracy and nationalism and of the arts and sciences from colonial times to late nineteenth century.

Hist 463. History of American Thought II. (3-0) Cr. 3. *Prereq: Sophomore classification.* Cravens. Religious, social, and political thought; development of democracy and nationalism, the arts and sciences from late nineteenth century to modern and post-modern times.

Hist 464. Nineteenth Century American Social History. (3-0) Cr. 3. *Prereq: Sophomore classification.* Schwieder. Rise of modern industrial society in nineteenth century America; family, churches, and other social institutions; reform, immigration, social and geographical mobility; impact of urbanization.

Hist 465. The American Frontier. (3-0) Cr. 3. *Prereq: Sophomore classification.* Taylor. History of Trans-Missouri West from 1840s to present. Emphasis on environment, Native Americans, minorities, women, federal government, and cities in settlement and regional identity.

Hist 467. History of United States Foreign Policy Through World War I. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Dobson. Diplomacy from the American Revolution; America's rise as a world power; First World War and post-war entanglements.

Hist 469. Contemporary America. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Kottman. Major political, economic, and diplomatic developments since 1969.

Hist 470. The United States and the Cold War I. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Kottman. Relationship between the U.S. and the Communist world from the Bolshevik revolution in 1917 to 1950.

Hist 471. The United States and the Cold War II. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* Kottman. Relationship between the U.S. and the Communist world from 1950 to the collapse of the Soviet system in 1991.

Hist 472. American Environmental History. (Same as Env S 472.) (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Taylor. Conceptual approach to human history in North America by examining the impact of nature from precontact through the 20th century. Explores material interactions; intellectual modes; aesthetic relationships; and management strategies from aboriginal society through the environmental age.

Hist 475. International Financial History. (3-0) Cr. 3. S. McCarthy. Business and economic cycles throughout history and the strategies investors and other decision-makers have developed to deal with them.

Hist 476. History of European Agriculture. (3-0) Cr. 3. *Prereq: Sophomore classification.* Avraamides, Plakans. A survey of the history of agricultural techniques, land-use patterns, and rural social forms in Europe from Neolithic revolution to present.

Hist 480. History of International Economic Integration. (3-0) Cr. 3. *Prereq: Sophomore classification.* McCarthy. Comparative history, with examples from around the world, of major types of economic groupings including government and business empires, associations of merchants, free trade areas, customs unions, and common markets.

Hist 481. History of Chemical Sciences and Their Technologies. (3-0) Cr. 3. *Prereq: Sophomore classification.* Development of theories and processes relating to the nature and transformation of matter in chemistry and associated engineering fields. Emphasis on chemistry and chemical theory since the seventeenth century and on creation of concepts and processes for controlled production of substances on an industrial scale since the eighteenth century.

Hist 482. History of the Life Sciences and Medicine. (3-0) Cr. 3. *Prereq: Sophomore classification.* Marcus. Emergence of human sciences and technologies—medicine, physiology, cytology, public health, and social sciences—in the social and cultural context of Western world.

Hist 483. History of Social and Behavioral Sciences. (3-0) Cr. 3. *Prereq: Sophomore classification.* Cravens. History of the social and behavioral sciences in Europe and America since the 18th century. Social and behavioral sciences and their applications in economics, agriculture, government, social relations, public health, mental health, the built environment, foreign affairs, military doctrine, and public education.

Hist 484. Science, Technology, Medicine, and Public Policy. (3-0) Cr. 3. *Prereq: Sophomore classification.* Bix. History of public policy in the U.S. on issues relating to science, technology, and medicine from WWII. Mechanics and politics of policy-making; case study approach to economic, ethical, environmental, intellectual, and social questions of policy from the A-bomb to genetic engineering and health care reform.

Hist 485. History of Physics and Physical Engineering. (Same as M E 485.) (3-0) Cr. 3. *Prereq: Sophomore classification.* Wilson. Interactions between physics and engineering associated with it, from the post-Newtonian era to the age of Einstein.

Hist 488. History of American Technology. (Same as M E 488.) (3-0) Cr. 3. *Prereq: Sophomore classification.* Bix. Technology in America from Industrial Revolution to present. Themes include social contexts of technological change, development of professional engineering, ideas about technology and American life.

Hist 489. History of American Science. (Same as M E 489.) (3-0) Cr. 3. *Prereq: Sophomore classification.* Cravens. Science as a cultural and social activity in America from the eighteenth century to present. Scientific discovery; interaction of scientific and social ideas; science and war; science and health, environment; role of science as expertise in a nationalistic democracy.

Hist 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq: 9 credits in history; permission of department chair.* No more than 9 credits of Hist 490 may be counted toward graduation. Reading and reports on problems selected in conference with each student.

Hist 495. Historiography and Research Writing. (1-0) Cr. R. F. S. *Prereq: Major in history.* Taken in conjunction with 400-level courses. Required of majors.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Hist 510. Proseminar in East Asian History. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.* Readings in East Asian history. Topics vary each time offered.

Hist 511. Proseminar in American History. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.* Readings in American history. Topics vary each time offered.

- A. Colonial Period
- B. Nineteenth Century
- C. Twentieth Century
- D. Environment

Hist 512. Proseminar in European History. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.* Readings in European history.

- A. Ancient (Same as Cl St 512A)
- B. Medieval
- C. Modern

Hist 513. Proseminar in Latin American History. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.* Readings in Latin American history. Topics vary each time offered.

Hist 514. Proseminar in Comparative Economic History. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.* Readings in comparative economic history. Topics vary each time offered.

Hist 530. Proseminar in Modern Russian/Soviet History. (3-0) Cr. 3 each time taken. *Prereq: Hist 422 or permission of instructor.* Andrews. Readings in modern Russian history. Topics in 530A and B vary each time offered.

- A. State, society, and culture in Soviet Russia, 1917-1991.
- B. Social history of Modern Russian technology and science, 1861-present.

Hist 550. Proseminar in European Agricultural History and Rural Studies. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.*

- A. Modern European Rural Life
- B. Twentieth Century Europe

Hist 552. Proseminar in American Agricultural History and Rural Studies. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.*

- A. American Agriculture
- B. The Southern Plantation
- C. Midwestern Rural Society
- F. Agrarian Reform Movements
- H. Women in Rural Life

Hist 554. Proseminar in Latin American Agricultural History and Rural Studies. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.*

- A. Caribbean Rural Life
- B. Comparative Slavery

Hist 556. Proseminar in Asian Agricultural History and Rural Studies. (3-0) Cr. 3 each time taken.

Prereq: Permission of instructor.

A. East Asian Agricultural-Rural Patterns

Hist 570. Seminar in General History of Science I. (3-0) Cr. 3. *Prereq: Permission of instructor.* Wilson. The history of science from pre-classical civilizations to the Age of Galileo with emphasis on the historical literature, varying interpretations of the period, and problems for continuing research.

Hist 571. Seminar in General History of Science II. (3-0) Cr. 3. *Prereq: Permission of instructor.* The history of science from Galileo to modern times, with emphasis on the historical literature, varying interpretations of the period, and problems for continuing research.

Hist 572. Seminar in American Environmental History. (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Taylor. History of human interaction with the North American environment from pre-European settlement through the 20th century. Emphasis on historical literature and topics for individual research.

Hist 574. Seminar in General History of Technology I. (3-0) Cr. 3. *Prereq: Permission of instructor.* Bix. The history of technology from pre-classical civilizations to the eve of the Industrial Revolution with emphasis on the historical literature, varying interpretations of the period, and problems for continuing research.

Hist 575. Seminar in General History of Technology II. (3-0) Cr. 3. *Prereq: Permission of instructor.* Marcus. The history of technology from the Industrial Revolution to modern times, with emphasis on the historical literature, varying interpretations of the period, and problems for continuing research.

Hist 576. Colloquium in Historiography of Technology and Science. (1-0) Cr. R. F. Topical lectures, reports, and discussion of methodology and research in history of technology and science. Required of all graduate students in history of technology and science program.

Hist 580. Museum Internship. Cr. varies each time taken. *Prereq: 15 graduate credits in history and permission of instructor.*

Hist 583. Historical Methods. (3-0) Cr. 3. Study of evidence, theory, and methods; 583C required of all M.A. students during their first fall semester.

B. Statistical Evidence and Analysis
C. Conceptual approach to history

Hist 585. Teaching Methods. Cr. 1 to 2 each time taken. *Prereq: Permission of instructor.* Topics vary each time offered.

B. Curriculum Development in History
C. Implementing Teaching Techniques

Hist 590. Special Topics. Cr. 1 to 3 each time taken. *Prereq: Permission of instructor.*

Hist 592. Seminar in East Asian History. (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Topics vary each time offered.

Hist 593. Seminar in American History. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.* Topics vary each time offered.

A. Colonial Period
B. Nineteenth Century
C. Twentieth Century

Hist 594. Seminar in European History. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.* Topics vary each time offered.

A. Ancient (Same as Cl St 594A)
B. Medieval
C. Modern

Hist 595. Seminar in Latin American History. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.* Topics vary each time offered.

Hist 597. Seminar in Comparative Economic History. (3-0) Cr. 3 each time taken. *Prereq: Permission of instructor.* Topics vary each time offered.

Hist 598. Introduction to Archives and Special Collections. (3-0) Cr. 2 each time taken. *Prereq: Graduate classification.*

Courses for Graduate Students

Hist 600. Seminar in Seventeenth and Eighteenth Century Science. (3-0) Cr. 3. *Prereq: Permission of instructor.* Wilson. Emphasis varies each time offered.

Hist 602. Seminar in Nineteenth Century Science. (3-0) Cr. 3. *Prereq: Permission of instructor.* Wilson. Emphasis varies each time offered.

Hist 603. Seminar in Nineteenth Century Technology. (3-0) Cr. 3. Alt. S. *Prereq: Permission of instructor.* Marcus, Bix. Emphasis varies each time offered.

Hist 604. Seminar in American Science. (3-0) Cr. 3. Alt. F. *Prereq: Permission of instructor.* Cravens, Marcus. Emphasis varies each time offered.

Hist 605. Seminar in American Technology. (3-0) Cr. 3. Alt. F. *Prereq: Permission of instructor.* Cravens, Bix. Emphasis varies each time offered.

Hist 606. Seminar in Early Twentieth Century Science. (3-0) Cr. 3. Alt. F. *Prereq: Permission of instructor.* Wilson, Cravens, Marcus. Emphasis varies each time offered.

Hist 607. Seminar in Early Twentieth Century Technology. (3-0) Cr. 3. Alt. S. *Prereq: Permission of instructor.* Bix, Marcus. Emphasis varies each time offered.

Hist 608. Seminar on European Rural Life. (3-0) Cr. 3. Plakans. *Prereq: Permission of Instructor.*

Hist 609. Seminar on Twentieth Century American Farm Policies. (3-0) Cr. 3. S. *Prereq: Permission of instructor.*

Hist 610. Seminar on American Rural Life. (3-0) Cr. 3. S. *Prereq: Permission of instructor.* Hurt.

Hist 699. Research.

Honors Program

Don Beitz, Chair, University Honors Program Committee

The Honors Program provides a vehicle for highly motivated and able students to pursue an innovative and challenging undergraduate education. Oversight of students' progress toward this goal is primarily the responsibility of the undergraduate colleges, each of which operates its own Honors Program. The college Honors Program committees admit students into the program, approve programs of study, and are responsible for the administration of their college Honors Program. The University Honors Program Committee, which includes the chairs of the college programs, is responsible for the general coordination of the college honors programs and the Freshman Honors Program.

Students in the Honors Program are offered a variety of academic opportunities designed to help them derive the fullest benefit from their undergraduate education. To enhance their individualized programs of study, students are offered numerous Honors courses, seminars, and independent research opportunities. (For other benefits, see *Honors Program*, p. 54.)

Honors courses and Honors sections of regular courses are offered by several departments and programs. These courses, open only to Honors Program members, have limited enrollment and are taught by specially selected instructors. Most of these courses are list-

ed by department or program. (See *Accounting, Aerospace Engineering and Engineering Mechanics, Chemistry, Classical Studies, Economics, Electrical Engineering, English, Materials Science and Engineering, Mathematics, Physics, Political Science, Psychology, and Speech Communication*.)

In addition to established Honors courses, Honors students may designate any course as an Honors course by making appropriate arrangements with the course instructor and obtaining approval of the Honors Program coordinator. Most departments offer opportunities for independent study and research under 290 and 490; when designated by an H, these courses also carry Honors credit.

Research grants are available to support Honors research.

Listed below are those courses that are offered directly by the University Honors Program. Specific information about the full range of Honors courses and seminars for the current academic year, including the Honors courses offered by individual departments and programs, may be obtained from the Honors Program Office in Osborn Cottage.

Hon 121. Freshman Honors Seminar. (0-2) Cr. 1. F. *Prereq: Membership in the Freshman Honors Program.* Orientation to Iowa State University and to the University Honors Program. Materials fee. Offered on a satisfactory-fail grading basis only.

Hon 290. Special Problems. Cr. var. *Prereq: Permission of the associate provost.* Independent study on topics of an interdisciplinary nature. Offered on a satisfactory-fail grading basis only. Intended primarily for freshmen and sophomores.

H. Honors.
U. Undergraduate Research

Hon 302. Honors Leadership Seminar. (1-2) Cr. 2. F. *Prereq: Selection as a leader of a Freshman Honors Seminar.* For students serving as leaders of Freshman Honors Seminars, under faculty supervision. Development of teaching and leadership skills within the context of an Honors education experience. Offered on a satisfactory-fail grading basis only.

Hon 305. Reflective Thinking: Culture. (3-0) Cr. 3. F. *Prereq: Membership in the University Honors Program.* Exploration of methodological and theoretical approaches to understanding culture. Emphasis on multiple interpretations of cultural artifacts, creators, audiences, and circumstances. Topics and media vary.

Hon 306. Methods and Issues: Science and Technology. (3-0) Cr. 3. S. *Prereq: Membership in the University Honors Program.* Analysis of practical, theoretical, and methodological issues in science and technology. Topics may range from research methods to ethics to predictions of trends in science and technology.

Hon 321, 322, 323, 324. University Honors Seminars. (1-0) Cr. 1 or (2-0) Cr. 2. F.S.SS. *Prereq: Membership in the University Honors Program.* Interdisciplinary seminars on topics to be announced in advance. Offered on a satisfactory-fail grading basis only.

Hon 490. Independent Study. Cr. var. *Prereq: Membership in the University Honors Program and permission of the vice provost for undergraduate programs.* Independent study on topics of an interdisciplinary nature. Intended primarily for juniors and seniors.

Horticulture

www.hort.iastate.edu/hort/

Michael H. Chaplin, Head of Department

Professors: Chaplin, Christians, Domoto, Graves, Hodges, Nonnecke, Taber

Professors (Emeritus): Bauske, Hall, Mahlstede, Schilleter, Weigle

Associate Professors: Gladon, Hannapel, Minner, Stephens, Summers

Assistant Professors: Delate, Evans, Hefley, Iles, Schuch

Assistant Professors (Collaborators): Widrlechner

Instructor (Adjunct): Gaul

Undergraduate Study

For undergraduate curriculum in horticulture leading to the bachelor of science degree, see *Horticulture, Curriculum*.

The horticulture curriculum is designed to permit commodity emphasis in general horticulture, landscape horticulture, greenhouse management, fruit production, vegetable production, nursery management, turfgrass science and management or horticultural communications and public education. Students considering graduate degrees should participate in the science option. Specialization options complete the educational goal by combining one of the above interest areas with those skills required in environmental horticulture, greenhouse management, fruit and vegetable production and management, nursery crop production and management, science option or turfgrass management.

Graduates possess the technical knowledge and skills to be a professional horticulturist. They understand plant growth and development and the culture and management of horticultural crops. They are able to communicate clearly and work effectively with others in the many disciplines of horticulture. Graduates understand the ethical and environmental dimensions of problems and issues facing horticultural professionals.

The rapidly expanding field of horticulture provides employment opportunities in nurseries, seed companies, interior landscaping firms, greenhouses, garden centers, conservatories, public gardens and arboreta, orchards, food processing companies, or vegetable farms. The allied industries associated with horticulture provide employment in the areas of sales and management. Turf managers are needed for golf courses, athletic fields, parks, and the lawn care industry. Further opportunities exist in sod production, landscape development and maintenance, and botanical gardens.

Opportunities also exist for further education in graduate school to prepare for a career in research, teaching, and extension.

Students have the option of selecting a secondary major in interdepartmental programs: pest management, seed science, agricultural extension education, environmental studies, or international agriculture (see *Index*).

The department offers a minor in horticulture that may be earned by taking Hort 221 plus at least 12 credits in horticulture at the 200 level or above.

Visit our departmental website at www.hort.iastate.edu/hort/

Graduate Study

The department offers master of science and doctor of philosophy degrees with a major in horticulture, and minor work for students in other departments. Under special circumstances a nonthesis master's degree is available through the master of agriculture program.

Prerequisite to major graduate study is the completion of courses covering horticulture, botany, and the underlying sciences.

Students majoring in horticulture usually will take minor work in agronomy, botany (cytology, morphology, or physiology), biochemistry, chemistry, entomology, food science and human nutrition, genetics, pathology, or statistics.

There is no uniform foreign language requirement for either the master of science or the doctor of philosophy degree.

The department also cooperates in the interdepartmental majors of genetics; water resources; molecular, cellular, and developmental biology, and plant physiology (see *Index*).

Graduates possess a broad understanding of horticulture and the underlying plant sciences. They are able to communicate effectively with members of the scientific community, industry groups, and the general public. They are experienced in conducting and writing the results of research. They are capable of addressing and solving complex problems associated with the agricultural and plant science professions. They understand the ethical, legal, social, and environmental issues associated with modern agricultural practices.

Courses open for nonmajor graduate credit: 351, 351L, 420, 422, 434, 435, 442, 451, 461, 471, 493.

Courses Primarily for Undergraduate Students

Hort 110. Orientation in Horticulture. (1-0) Cr. R. F. Introduction to the field of horticulture.

Hort 121. Home Horticulture. (2-0) Cr. 2. F.S.SS. Growing plants in and around the home including requirements for growing house plants; plant propagation; designing and maintaining flower, fruit, and vegetable gardens: lawn, tree, and shrub maintenance.

Hort 123. Home Horticulture Indoor Plant Recitation. (1-0) Cr. 1. F.S. Demonstrations and activities: plant identification, plant propagation, terrarium construction, carnivorous plants, bonsai, and floral design. Plant materials fee.

Hort 124. Home Horticulture Garden Plant Recitation. (1-0) Cr. 1. F.S. Demonstrations and activities that illustrate the principles of growing garden plants. Plant selection and garden design for landscape, fruit, and vegetable gardens; plant propagation; and plant identification. Plant materials fee.

Hort 221. Principles of Horticulture. (2-2) Cr. 3. F.S. *Prereq:* Biol 201. Biological principles of growing horticultural crops including anatomy, reproduction,

light, temperature, water, nutrition, and growth and development. Laboratory exercises emphasize environmental factors and permit detailed observation of plant growth.

Hort 233. Herbaceous Ornamental Plants. (2-2) Cr. 3. F. *Prereq:* 221. Identification, botanical characteristics, origins, propagation, uses and general culture of herbaceous annual and perennial plants.

Hort 241. Woody Landscape Plants I. (2-3) Cr. 2. F. First 10 weeks. The identification, botanical characteristics, landscape values, and culture of native and introduced woody plants used in landscapes in the Middle West. Emphasis on deciduous shade trees and shrubs.

Hort 243. Woody Landscape Plants II. (2-3) Cr. 1. S. Last 5 weeks. The identification, botanical characteristics, landscape values, and culture of native and introduced woody plants used in landscapes in the Middle West. Emphasis on evergreens and plants with showy spring flowers. A full-day field trip is required. Field trip fee.

Hort 253. Tropical Plants and Interiorscapes. (2-2) Cr. 3. Alt. S., offered 2000. *Prereq:* 221. Identification, nomenclature, culture, and use of tropical plants in interior landscapes. Understanding plant needs in interior environments such as malls, offices, and lobbies. Planning, designing, installation, maintenance, and selection of plants for interiorscapes.

Hort 283. Pesticide Application Certification. (Same as Ent 283.) See *Entomology*.

Hort 321. Horticulture Physiology. (2-0) Cr. 2. F. *Prereq:* 221 or Biol 201. Principles of plant physiology relating to problems in horticulture including photosynthesis, respiration, metabolisms, water relations, and developmental processes.

Hort 322. Plant Propagation. (2-2) Cr. 3. S. *Prereq:* 221 or Biol 202. Fundamental principles underlying sexual and asexual propagation of plants; practice in reproducing plants by use of seeds, leaves, stems, and roots. Materials fee.

Hort 332. Greenhouse and Controlled Environments. (3-3) Cr. 4. F. *Prereq:* 221. Principles of greenhouse and controlled environment operation and management. Methods of monitoring and manipulating environmental conditions (light, temperature, fertility, production media, etc.) to maximize production and quality and minimize production costs and time. Materials fee.

Hort 338. Seed Science and Technology. (Same as Agron 338.) See *Agronomy*.

Hort 341. Woody Plant Cultivars: Shade Trees. (2-2) Cr. 1. Alt. F., offered 1999. Five-week course beginning third week of semester. Students will learn how to identify and care for the most horticulturally important shade tree taxa suitable for the Midwest. Cultivars of the most prevalent species also will be taught. Each class period will feature indoor and outdoor sessions.

Hort 342. Landscape Establishment and Maintenance. (2-3) Cr. 3. F. *Prereq:* 241 and 243 or L A 321. Principles and practices involved with establishment and maintenance of woody ornamental plants and turfgrasses in the landscape. Laboratory work involves reading blueprints, staking sites for location and grade, planting, and maintaining plant materials.

Hort 344. Landscape Horticulture. (Same as L A 344.) (2-6) Cr. 4. S. *Prereq:* 241 and 243 or L A 321 *recommended*. Principles and practices of designing residential and small business landscapes. Site analysis, terrain alteration for drainage and aesthetics, functional areas and circulation, use of construction and plant materials for site development. Basic sketching and drafting, perspective drawing, and plan refinement techniques. Materials fee, field trip fee.

Hort 351. Turfgrass Establishment and Management. (Same as Agron 351.) (3-0) Cr. 3. F. *Prereq:* 221 or Agron 114 or Biol 201. Principles and practices of turfgrass propagation and management. Specialized practices relative to home lawns, golf courses, athletic fields, highway roadsides, and seed and sod production. The biology and control of turfgrass pests. Nonmajor graduate credit.

Hort 351L. Turfgrass Establishment and Management Laboratory. (Same as Agron 351L.) (0-3) Cr. 1. F. *Prereq: Credit or enrollment in 351.* Those enrolled in the horticulture curriculum are required to take 351L in conjunction with 351 except by permission of the instructor. Nonmajor graduate credit.

Hort 391. Horticultural Management Experience. Cr. arr., maximum of 2. F.S.SS. *Prereq: 221, permission of instructor.* A structured work experience for the student to gain insight into management operations associated with production of horticultural crops. A report of 10 or more pages describing the student's experience is required. One credit is given for each term the student is enrolled in the course. A maximum of two credits may be used toward the horticultural sciences course requirements, and two additional credits may be used toward the 128 credits required for graduation.

Hort 420. Plant Nutrition. (Same as PI HP 420.) (2-2) Cr. 3. S. *Prereq: 221 or Agron 114 or Biol 201 and Agron 154 or 155; junior or senior classification.* Factors influencing nutrient absorption and composition: criteria of essentiality and roles of the elements; nutrient status and plant analysis techniques; deficiency and toxicity symptoms, the laboratory emphasizes techniques for determining plant nutritional status, water quality, and crop monitoring. Nonmajor graduate credit.

Hort 421. Case Studies in Environmental Stress Physiology. (Dual-listed with 521.) (2-2) Cr. 3. Alt. S., offered 2001. *Prereq: 321 or Bot 320.* Examine environmental factors affecting plant health. Drought, flooding, heat, cold temperatures, and dormancy are examples of study modules. Interdisciplinary topics include plant pathology and entomology. Woody and herbaceous plants, food crops, and ornamental plants.

Hort 422. Postharvest Technology. (2-3) Cr. 3. Alt. F., offered 1999. *Prereq: 221, junior or senior classification.* Principles, methods, and techniques related to postharvest maintenance of quality of horticultural commodities. Emphasis on the effects of handling, storage facilities and techniques, and quality evaluation. Field trips. Nonmajor graduate credit.

Hort 423. Plant Tissue, Cell, and Protoplast Culture. (Dual-listed with 523.) (1-2) Cr. 2. Alt. S., offered 2000. *Prereq: Biol 301 and Hort 321 or Bot 320.* Theory and techniques of plant tissue culture, including organogenesis, somatic embryogenesis, micropropagation, anther and embryo culture, protoplast isolation and culture, and transformation. Applications to agriculture. Materials fee.

Hort 424. Sustainable and Environmental Horticulture Systems. (Dual-listed with 524; same as Env S 424.) (2-0) Cr. 2. S. Inquiry into ethical issues and environmental consequences of horticultural cropping systems and production practices. Emphasis on production systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

Hort 425. Horticultural Plant Breeding. (Dual-listed with 425.) (2-0) Cr. 2. Alt. F., offered 2000. *Prereq: Biol 301 or Gen 320.* Breeding techniques and methods required for the improvement of horticultural plants.

Hort 434. Greenhouse Crop Production I. (2-3) Cr. 3. Alt. F., offered 1999. *Prereq: 332.* Principles and practices of greenhouse crops production. Emphasis is placed on production of common containerized flowering and ornamental foliage species and vegetable crops produced in greenhouse environments. Materials fee. Nonmajor graduate credit.

Hort 435. Greenhouse Crop Production II. (2-3) Cr. 3. Alt. S., offered 2000. *Prereq: 233 and 332.* Principles and practices of greenhouse crops production. Emphasis is placed on production of bulb crops and flowering annual and perennial crops. Materials fee. Nonmajor graduate credit.

Hort 442. Nursery Crop Production. (2-2) Cr. 3. F. *Prereq: 241 and 243 or L.A. 321, Agron 154 or 155.* Management decisions involved with the operation of a production nursery including: selection of a nursery site; soil and nutrition management for field and

container-grown nursery plants; plant growth, irrigation, storage facilities. Nonmajor graduate credit.

Hort 444. Landscape, Athletic Field and Golf Course Construction. (2-3) Cr. 3. F. *Prereq: Junior or senior classification.* Theory and practice of construction or installing landscape features including layout, contours, retaining walls, paving, irrigation, and specialized turf facilities such as sand base athletic fields and golf course greens. Materials fee, field trip fee.

Hort 451. Professional Turfgrass Management. (2-0) Cr. 2. Alt. S., offered 2001. *Prereq: 351.* Turfgrass science including the study of (1) specific information on soil chemistry and soil modification as they relate to the development and maintenance of turfgrass areas, (2) specialized management practices used in athletic field care, professional lawn care and golf course industries, and (3) construction methods for golf courses and athletic fields. Nonmajor graduate credit.

Hort 452. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 552; same as PI P 452, Ent 452.) See *Plant Pathology or Entomology.*

Hort 461. Fruit and Nut Crop Production. (2-2) Cr. 3. Alt. S., offered 2001. *Prereq: 221.* Principles and practices of small fruit, tree fruit, and nut culture and production. Morphology, physiology of growth and development, plant establishment, pest management, pruning, training, harvesting, storage, and marketing. Nonmajor graduate credit.

Hort 471. Vegetable Crop Production. (3-0) Cr. 3. Alt. S., offered 2000. Principles and practices of vegetable production. Methods of maximizing yield and quality of vegetables. Harvesting, storage, and marketing. Nonmajor graduate credit.

Hort 475. Community Tree Management. (Same as For 475.) See *Forestry.*

Hort 490. Independent Study. Cr. arr. *Prereq: Senior classification in horticulture, permission of instructor.* A maximum of 4 credits of 490 may be used toward the total of 128 credits required for graduation. Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head.

- A. Greenhouse Management
- B. Nursery Crops
- C. Turfgrass
- D. Fruit Crops
- E. Vegetable Crops
- F. Cross-Commodity
- H. Honors

Hort 493. Workshop in Horticulture. Cr. arr. Off campus. Offered as demand warrants. Workshops in horticulture. Nonmajor graduate credit.

Hort 496. Horticulture Travel Course. Cr. 1-3. May be repeated. *Prereq: Permission of instructor.* Limited enrollment. Study and tour of production methods in major horticultural regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, cultures, and history of horticultural crops. Location and duration of tours will vary. Tour expenses paid by students. Field trip fee.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Hort 521. Case Studies in Environmental Stress Physiology. (Dual-listed with 421.) (2-2) Cr. 3. Alt. S., offered 2001. *Prereq: 321 or Bot 320.* Examine environmental factors affecting plant health. Drought, flooding, heat, cold temperature, and dormancy are examples of study modules. Interdisciplinary topics include plant pathology and entomology. Woody and herbaceous plants, food crops, and ornamental plants.

Hort 523. Plant Tissue, Cell, and Protoplast Culture. (Dual-listed with 423.) (1-2) Cr. 2. Alt. S., offered 2000. *Prereq: Biol 301 and Hort 321 or Bot 320.* Theory and techniques of plant tissue culture, including organogenesis, somatic embryogenesis, micropropagation, anther and embryo culture, protoplast isolation and culture, and transformation. Applications to agriculture. Materials fee.

Hort 524. Sustainable and Environmental Horticulture Systems. (Dual-listed with 424.) (2-0) Cr. 2. S. Inquiry into ethical issues and environmental consequences of horticultural cropping systems and production practices. Emphasis on production systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

Hort 525. Horticultural Plant Breeding. (Dual-listed with 425.) (2-0) Cr. 2. Alt. F., offered 2000. *Prereq: Biol 301 or Gen 320.* Breeding techniques and methods required for the improvement of horticultural plants.

Hort 529. Publishing in Plant Science Journals. (2-0) Cr. 2. S. *Prereq: Permission of instructor; evidence of a publishable unit of the student's research data.* Process of preparing a manuscript for submission to a refereed journal in the plant sciences. Emphasis on publishing self-generated data from thesis or dissertation research.

Hort 530. Research Orientation. (2-0) Cr. 1. F. Instruction in scientific methods and communication skills.

Hort 551. Growth and Development of Perennial Grasses. (Same as Agron 551.) (2-0) Cr. 2. S. *Prereq: Bot 321.* The grass plant. Selected topics on anatomy, morphology, and physiology relative to growth and development of perennial grasses. Emphasis on growth and development characteristics peculiar to grasses and variations of such characteristics under natural and managed conditions.

Hort 552. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 452; same as PI P 552.) See *Plant Pathology or Entomology.*

Hort 590. Special Topics. Cr. arr. *Prereq: A major or minor in horticulture.*

Hort 593. Workshop in Horticulture. Cr. arr. Workshops in horticulture, with emphasis on off-campus instruction.

- A. Greenhouse Management
- B. Nursery Crops
- C. Turfgrass
- D. Fruit Crops
- E. Vegetable Crops
- F. Cross-Commodity

Hort 599. Creative Component. Cr. arr.

Courses for Graduate Students

Hort 610. Graduate Seminar. Cr. 1 each time elected. F.S.

Hort 615. Liquid Chromatography. (2-3) Cr. 1. Second 5 weeks. Alt. F., offered 1999. *Prereq: Permission of instructor, graduate classification.* Theory and application of analytical liquid chromatography. Considerations in methods development: column packing, particle size, solvent selection, isocratic vs. gradient separation, solvent flow rate, detector choice, qualitative component analysis, and data handling. Materials fee.

Hort 617. Analysis of Plant Tissues by Plasma Emission Spectroscopy. (3-0) Cr. 1., first 5 weeks. Alt. S., offered 2001. *Prereq: Permission of instructor, graduate classification.* Theory and application of inductively coupled argon plasma spectroscopy for the simultaneous determination of metals in plant tissues. Specific methodology of sample preparation, use of national plant reference standards, instrument calibration and calibration statistics, and interpretation of analyses.

Hort 620. Biotechnology of Horticultural Crops. (3-0) Cr. 1., first 5 weeks. Alt. F., offered 2000. *Prereq: BBMB 405 or Bot 545.* Improvement of horticultural crops using techniques of molecular biology with emphasis on examples of successful transgenic systems in cultivated species. Specific biotechnology approaches dealing with problems related to defense and resistance systems, stress biology, postharvest physiology, yield and quality parameters, and nutrition.

Hort 622. Ethylene I: Ethylene Chemistry, Biosynthesis, and Mode of Action. (3-0) Cr. 1., first 5 weeks. Alt. S., offered 2000. *Prereq: Bot 320 or equivalent; BBMB 301 or 404 or equivalent.*

Chemistry and methods of chemical analysis of ethylene. Gas exchange physiology with ethylene as the model compound. Pathway, enzymology, and inhibition of ethylene biosynthesis in higher plants. Biochemistry and inhibition of ethylene mode of action. Ethylene usage in agricultural systems of higher plants.

Hort 623. Ethylene II: Ethylene in Growth, Development, and Stress Systems. (3-0) Cr. 1., second 5 weeks. Alt. S., offered 2000. *Prereq:* 622. The role of ethylene as a modulator of vegetative plant growth and development. Effects of ethylene on cellular physiology, organ dormancy, and other anatomical and morphological changes during growth and development of vegetative higher plant tissues and organs. Role of ethylene in biotic and abiotic stress systems.

Hort 624. Ethylene III: Ethylene in Abscission, Ripening, and Senescence Systems. (3-0) Cr. 1., second 5 weeks. Alt. S., offered 2000. *Prereq:* 622. The role of ethylene in flower, flower part, and leaf abscission processes. Emphasis on the physiological mechanisms and underlying molecular biology of ethylene synthesis and mode of action during maturation, ripening, and senescence of higher plant tissues and organs.

Hort 625. Postharvest Physiology. (3-0) Cr. 1., third 5 weeks. Alt. S., offered 2000. *Prereq:* 622, 624. Respiratory gas exchange physiology, respiration, respiratory pathways and metabolism, pigment changes, carbohydrate metabolism, cellular integrity, and gene expression events during the postharvest period of higher plant tissues and organs.

Hort 690. Advanced Topics. Cr. var.

Hort 696. Seminar in Plant Physiology and Molecular Biology. (Same as Bot 696.) See *Botany*.

Hort 699. Thesis and Dissertation Research. Cr. var.

- A. Greenhouse Management
- B. Nursery Crops
- C. Turfgrass
- D. Fruit Crops
- E. Vegetable Crops
- F. Cross-Commodity

Hotel, Restaurant, and Institution Management

Mary B. Gregoire, Chair of Department

Professors: Gregoire

Associate Professors: Baltzer, Brown, Gilmore, Huss, Walsh

Assistant Professors: Oh

Assistant Professors (Adjunct): Burger, Dana, Strohbeh

Instructors (Adjunct): Cawdron, Giddens, Larson, Metzger, Parrish, Petersen, Severson, Snyder, Voelkers

Instructors (Collaborators): Thorius

Undergraduate Study

The mission of the Department of Hotel, Restaurant, and Institution Management (HRIM) addresses the professional management of organizations that provide food and lodging services to individuals and families away from home. Educational experiences are planned to contribute to the graduate's effectiveness as a career professional and as a person, family member, and citizen. Research and extension efforts are conducted with the

purpose of improving quality of services and management effectiveness within lodging and foodservice organizations. Finally, the department is committed to serving the respective missions of Iowa State University and the College of Family and Consumer Sciences and to serving the needs of the state of Iowa.

The department offers work for the degree bachelor of science in hotel, restaurant, and institution management. Coursework is planned to provide students with a general education plus professional preparation for supervisory and executive positions in hospitality organizations. Principles of business management are presented, as well as fundamentals of hospitality operations.

Graduates understand the principles necessary to successfully practice hospitality management in an ethical manner. They are able to determine, accept, and implement management responsibilities. They can identify and evaluate environmental trends and adapt operating practices to meet these changing forces. They are able to make a positive contribution to the growth and improvement of the hospitality industry.

Learning experiences are provided in the quantity food production and service facility of the HRIM Department and other approved establishments. Field trips and guest speakers are scheduled to introduce students to the diversity of career opportunities in the hospitality industry. These opportunities apply course content to specific work settings. Students are required to have 400 hours of relevant work experience prior to graduation.

The HRIM Department offers a minor that may be earned by successfully completing 16-17 credits as follows: 288, 380, 380L, 433, and 8-9 credits selected from 300 - or 400-level HRIM courses in consultation with the designated faculty adviser.

A hotel, restaurant, and institution management area of concentration can be combined with a major in advertising or journalism and mass communication in the College of Liberal Arts and Sciences. See the department for details.

The department requires a grade of C or better in both Engl 104 and 105 or equivalent transfer courses. A student who does not get a C or better in these classes is required to get a C or better in Engl 302.

Graduate Study

The department offers work for the degree master of science with a major in hotel, restaurant, and institution management. This is a general hospitality management program.

Graduates of the program are able to interpret trends and adapt operating practices of hospitality organizations to changing economic, social, political, technological, and environmental conditions. They can manage a food or lodging enterprise successfully to achieve objectives of the operation or, at the doctoral level, successfully carry out responsibilities of a hospitality educator. Graduates will make positive contributions to the growth and improvement of the hospitality industry using

current research in the decision-making process.

A degree in hotel, restaurant, and institution management is the usual background for graduate study; however, applicants with preparation in dietetics, business, or closely-related fields are encouraged to apply. Prior to admission, students must have completed most prerequisite courses. These include basic principles courses in accounting, business law, business finance, computer science, economics, human resources, management, and marketing. In addition, basic principles courses in nutrition, food preparation, and quantity food preparation are required.

The master of science degree requires either a thesis or non-thesis (creative component) project. Students also are required to take one HRIM course in three of four core areas (human resources, financial management, marketing, and strategic management).

The department also participates in the Master of Family and Consumer Sciences degree by offering a specialization with that program.

Work may be taken for the degree doctor of philosophy as a joint major. A second major must be chosen from a related area offered by a department authorized to grant a doctoral degree. Common choices for joint-major programs have been family and consumer sciences education and higher education. A research dissertation is required.

Courses open for nonmajor graduate credit: 352, 438, 452, 460.

Courses Primarily for Undergraduate Students

HRI 233. Hospitality Sanitation and Safety. (3-0) Cr. 3. F.S. Sanitation and safety principles and issues in food service and lodging operations. Application of HACCP. Preparation for national foodservice sanitation certification examination. Characteristics of food, supplies, and equipment as related to sanitation and safety.

HRI 287. Introduction to Hospitality Management. (3-0) Cr. 3. F.S. Introduction to management concepts and principles with application to the hospitality industry. Includes service quality management. Emphasis on the process approach to management. Credit for either 391 or 287 and 438 may count toward graduation.

HRI 288. Introduction to the Hospitality Industry. (3-0) Cr. 3. F. Introduction to the foodservice, lodging, and tourism components of the hospitality industry. Background information, current issues, and future challenges in various segments of the industry.

HRI 289. Private Club Operations. (2-0) Cr. 2. F. *Prereq:* 288. The organization and management of various types of private clubs including city, country, and other recreational and social clubs. Field trip and fee required.

HRI 333. Foodservice Operations Controls. (3-0) Cr. 3. F.S. *Prereq:* Credit or enrollment in 380 and 380L. Introduction to cost control in foodservice operations: systems for controlling sales and food, beverage, labor, and other costs. Application of principles related to procurement, production, and inventory controls. Specifications for food, supplies, and equipment.

HRI 352. Lodging Operations Management I. (3-0) Cr. 3. F.S. *Prereq:* 288. Introduction to functional department activities of lodging organizations, including front office, housekeeping, purchasing, accounting, human resources, and food and beverage. Introduction to property management systems.

Principles of management applied to lodging operations.

HRI 360. Tourism Management. (3-0) Cr. 3. S. *Prereq:* 288. Overview of the tourism industry, including transportation, hospitality and related services, and destinations/attractions. Introduction to travel behavior, tourism planning and research, and economic and social impacts of tourism development.

HRI 380. Quantity Food Production Management. (3-0) Cr. 3. F.S.SS. *Prereq:* 233 or 2 cr. *Micro:* FS HN 211 or 214, enrollment in 380L. Principles of and procedures used in quantity food production management including quality control, food costing, work methods, menu planning, sanitation, safety, and service.

HRI 380L. Quantity Food Production and Service Management Experience. (0-6) Cr. 2. F.S.SS. *Prereq:* 233 or 2 cr. *Micro,* FS HN 211 or 214, enrollment in 380, reservation with department required. Application of quantity food production and service management principles and procedures in the departmental foodservice operation.

HRI 381. International Study in Hospitality. Cr. 1-3. SS. *Prereq:* Permission by application. Limited enrollment. Supervised study abroad of tourism and its impact on hospitality operations. Experiences include hospitality-related tourist attractions and opportunities related to different cultures. Required pre-study sessions arranged. Expenses paid by student. Field trip fee.

HRI 383. Introduction to Beverages. (2-0) Cr. 2. F. *Prereq:* Credit or enrollment in 380, 380L; must be at least 21 years old. Introduction to history and methods of production for a variety of wines, spirits, and other beverages. Product knowledge and service techniques related to sales. Materials fee.

HRI 391. Foodservice Systems Management I. (3-0) Cr. 3. F. *Prereq:* Credit or enrollment in 380, 380L. Principles and techniques related to basic management, organizational leadership, and human resource management of foodservices in health care and other institutional settings. Not accepted for credit toward a major in HRIM. Credit for either 391 or 287 and 438 may count toward graduation.

HRI 392. Foodservice Systems Management II. (3-0) Cr. 3. S. *Prereq:* Credit or enrollment in 380, 380L. Introduction to cost control in foodservice departments: procedures for controlling food, labor, and other variable costs. Application of principles related to food product selection, specification, purchase, and storage in health care and other institutions. Not accepted for credit toward a major in HRIM. Credit for either 392 or 333 may count toward graduation.

HRI 393. Hospitality Work Experience. Cr. 1. *Prereq:* Adviser approval. Approved work experience for HRIM majors in food, lodging, or related operations. Experience in at least two different entry-level positions or management responsibilities after high school graduation required. A minimum of 400 hours required. Offered on a satisfactory-fail grading basis only.

HRI 433. Hospitality Managerial Accounting. (Dual-listed with 533.) (3-0) Cr. 3. F.S. *Prereq:* Acct 284 and credit or enrollment in 333. Use of financial statements; balance sheet, income statement, cash flows statement; ratio analysis; cost concepts and behavior; cost-volume-profit analysis; cost-based pricing; forecasting; operating budgets; cash control and management; internal control; capital budgeting; lease accounting; and income taxes.

HRI 437. Hospitality Management Information Systems. (3-0) Cr. 3. F. *Prereq:* 333, 352; Com S 103. Introduction to hospitality management information systems. Property management interfaces. Managerial decision making and problem solving using computers. Selecting and purchasing computer equipment. Managing internal and external communication networks.

HRI 438. Hospitality Human Resource Management. (3-0) Cr. 3. S. *Prereq:* 287, credit or enrollment in 380, 380L. Principles and practices of human resource management relevant to hospitality

organizations. Emphasis on the manager's role in hospitality organizations. Credit for either 391 or 287 and 438 may count toward graduation. Nonmajor graduate credit.

HRI 439. Cases in Hospitality Human Resource Management. (Dual-listed with 539.) (3-0) Cr. 3. F. *Prereq:* 438. Emphasis on the work force and work environment in hospitality organizations. Case studies.

HRI 440. Hospitality Marketing. (Dual-listed with 540.) (3-0) Cr. 3. F. *Prereq:* 287 and Stat 101, credit or enrollment in Mkt 340. Application of marketing theories to the hospitality industry. Emphasis on consumer behavior, market opportunities, marketing research and strategies, and marketing plans. Case studies.

HRI 452. Lodging Operations Management II. (3-0) Cr. 3. S. *Prereq:* 352 and Com S 103. Advanced topics in lodging operations, including international project development, operations, and contracts. Property management systems including computer exercises. Principles of yield management. Case studies. Nonmajor graduate credit.

HRI 455. Hospitality Strategic Management. (Dual-listed with 555.) (3-0) Cr. 3. F. *Prereq:* Credit or enrollment in 433, 438, and 440; senior classification. Introduction to the strategic management process as a planning and decision-making framework in hospitality organizations. Integration of human resources, operations, marketing and financial management concepts. Use of case studies and group projects to facilitate development of conceptual and analytical skills.

HRI 460. Hospitality Law. (3-0) Cr. 3. S. *Prereq:* Acct 215. Laws relating to ownership and operation of hospitality organizations. The responsibility of management and employees to customers and society. Case studies. Nonmajor graduate credit.

HRI 480. Quantity Food Development. (1-3) Cr. 2. Alt. F., offered 1999. *Prereq:* 380, 380L, FS HN 214 or 411. Experimental approach to the development of quantity recipes. Emphasis on sensory evaluation; parameters of time, equipment, ingredients, and reporting results.

HRI 485. Catering. (Dual-listed with 585.) (2-0) Cr. 2. S. *Prereq:* 380, 380L. Application of management principles in a catering business. Starting a catering business and developing a business plan.

HRI 487. Fine Dining Management. (Dual-listed with 587.) (0-4) Cr. 2. S. *Prereq:* 380, 380L. Creative experiences with U.S. regional and international foods appropriate for fine dining. Application of management principles in food preparation and service in fine dining operations. Emphasis on ethnic foods, religious restriction on foods, and other cultural implications for fine dining management. Exploration of the historical and cultural development of the world food table.

HRI 490. Independent Study. Cr. arr. *Prereq:* Sections B-E: Department approval; Section H: Full membership in Honors Program.
B. Hospitality Management
D. Lodging Operations
E. Foodservice Operation
H. Honors

HRI 491. Internship. Cr. 2. *Prereq:* Department approval. Offered on a satisfactory-fail grading basis only.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

HRI 500. Short Course. Cr. arr. *Prereq:* 6 credits in hotel, restaurant, and institution management and permission of instructor.

HRI 504. Seminar. (0-2) Cr. 1. F.(A), S.(B). 504B may be taken more than once for credit.
A. Hospitality Research
B. Current Issues

HRI 533. Hospitality Managerial Accounting. (Dual-listed with 433.) (3-0) Cr. 3. F.S. *Prereq:* Acct 284 and credit or enrollment in 333. Use of financial statements; balance sheet, income statement, cash flows

statement; ratio analysis; cost concepts and behavior; cost-volume-profit analysis; cost-based pricing; forecasting; operating budgets; cash control and management; internal control; capital budgeting; lease accounting; and income taxes.

HRI 539. Cases in Hospitality Human Resource Management. (Dual-listed with 439.) (3-0) Cr. 3. F. *Prereq:* 438. Emphasis on the work force and work environment in hospitality organizations. Case studies.

HRI 540. Hospitality Marketing. (Dual-listed with 440.) (3-0) Cr. 3. F. *Prereq:* 287, credit or enrollment in Mkt 340. Application of marketing theories to the hospitality industry. Emphasis on consumer behavior, market opportunities, marketing research and strategies, and marketing plans. Case studies.

HRI 555. Hospitality Strategic Management. (Dual-listed with 455.) (3-0) Cr. 3. F. *Prereq:* Credit or enrollment in 433, 438, and 440. Introduction to the strategic management process as a planning and decision-making framework in hospitality organizations. Integration of human resources, operations, marketing and financial management concepts. Use of case studies and group projects to facilitate development of conceptual and analytical skills.

HRI 575. Professional Management Experience in the Hospitality Industry. Cr. 2-4. F.S.SS. *Prereq:* 9 credits in hotel, restaurant, and institution management at 400 level or above and permission of instructor. Analysis and interpretation of professional functions and data in a hospitality organization. Design and implementation of a management project.

HRI 585. Catering. (Dual-listed with 485.) (2-0) Cr. 2. S. *Prereq:* 380, 380L. Application of management principles in a catering business. Starting a catering business and developing a business plan.

HRI 587. Fine Dining Management. (Dual-listed with 487.) (0-4) Cr. 2. S. *Prereq:* 380, 380L. Creative experiences with U.S. regional and international foods appropriate for fine dining. Application of management principles in food preparation and service in fine dining operation. Emphasis on ethnic foods, religious restriction on foods, and other cultural implications for fine dining management. Exploration of the historical and cultural development of the world food table.

HRI 590. Special Topics. Cr. arr. Credit maximum of 3 per topic. *Prereq:* 9 credits in hotel, restaurant, and institution management at 400 level or above and permission of instructor.

- B. Hospitality Management
- D. Lodging Operations
- E. Foodservice Operations

HRI 593. Workshops. Cr. arr. *Prereq:* 6 credits in hotel, restaurant, and institution management and permission of instructor.

HRI 599. Creative Component.

Courses for Graduate Students

HRI 601. Hospitality Financial Management. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 3 credits in business finance. Financial management in foodservice and lodging operations. Emphasis on financial performance, risk and value evaluation, cash flow analysis, and investment and financing decisions.

HRI 608. Administrative Problems. Cr. arr. May take up to 4 cr. *Prereq:* 9 credits in hotel, restaurant, and institution management at 400 level or above and permission of instructor. Consideration of advanced administrative problems. Case studies in foodservice, lodging or other approved establishments.

HRI 611. Hospitality Marketing Strategies. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 3 credits principles of marketing and statistics. Formulation, implementation, and control of strategic marketing plans in hospitality organizations. Analysis of cases related to the hospitality industry.

HRI 639. Management of Professionals in Profit and Non-profit Organizations. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 439 or 539 or 3 years in supervisory position. Theories of leadership and management applied to selected profit or non-profit organiza-

tions. Principles and practices related to recruitment, selection, and development of professional personnel in hospitality, health care and similar service-related work settings.

HRI 675. HRIM Teaching Experience. Cr. 2. F.S. Prereq: 9 credits in hotel, restaurant, and institution management at 400 level or above and permission of instructor. Development of objectives, teaching methods and materials, and test items for selected topics. Implementation in an HRIM course.

HRI 699. Research.

Housing

(Interdepartmental Graduate Minor)

Supervisory Committee: C. Cook, Chair; S. Crull, R. A. Findlay, D. L. Fowles, V. Ryan, M. R. Wong

The Housing minor provides graduate students with an understanding of the interrelationships among the planning, design, policy, distribution and consumption aspects of human housing. Of special importance in the program is the interplay of the social sciences with the planning, design and policy professions.

Work in the housing minor is offered for students pursuing any graduate degree. The cooperating departments are Anthropology, Architecture, Art and Design, Community and Regional Planning, Economics, Educational Leadership and Policy Studies, Family and Consumer Sciences Education and Studies, Human Development and Family Studies, Landscape Architecture, Political Science, Sociology, and Textiles and Clothing.

Students who complete a minor in this graduate program are able to describe and report on the dimensions of human housing. They complete projects which illustrate an understanding of the role of the social sciences in housing planning, design and policy.

Course requirements include: Hous 500, Hous 562 and courses listed below for a total of nine credits if the thesis subject is housing and twelve credits if it is not. In addition, the student is encouraged to take at least one course in statistics or research methods.

The program of study committee of a student minoring in housing shall include a member of the Housing Faculty from outside the student's major(s).

Interested students may contact the chairperson of the supervisory committee for complete lists of housing and research courses and of housing faculty members.

Courses open for nonmajor graduate credit: 471.

Courses Primarily for Undergraduate Students

Hous 471. Design for All People. (Same as Arch 471.) See *Architecture*. Nonmajor graduate credit.

Courses for Graduate Students, open to qualified undergraduates

Hous 500. Housing Colloquia. Cr. 1 each time taken, maximum of 3. S. Offered on a satisfactory-fail grading basis only.

Hous 515. Housing. (Same as C R P 515.) See *Community and Regional Planning*.

1999-2001

Hous 517. Urban Revitalization. (Same as C R P 517.) See *Community and Regional Planning*.

Hous 521. Housing and the Social Environment. (Same as HD FS 521.) See *Human Development and Family Studies*.

Hous 560. Housing and Environments for Children. (Same as HD FS 560.) See *Human Development and Family Studies*.

Hous 562. Housing Design Issues. (Same as Arch 562.) See *Architecture*.

Hous 563. Housing and Environments for the Elderly. (Same as HD FS 563.) See *Human Development and Family Studies*.

Hous 565. Interior Design Studio. (Same as ArtID 565.) See *Art and Design*.

Hous 566. Housing for Specific Groups. (Same as Arch 566.) See *Architecture*.

Hous 660. Research Methods. (Same as ArtID 660.) See *Art and Design*.

Human Development and Family Studies

Maurice M. MacDonald, Chair of Department

Professors: Brooke, Crase, Draper, Fletcher, Hira, Joanning, Lempers, MacDonald, Martin, Meeks, Mercier, Winter

Professors (Collaborators): Bruner

Distinguished Professors (Emeritus): Bivens, Meixner

Professors (Emeritus): Budolfson, Coulson, Deacon, Engel, Galejs, Petersen, Pickett, Schwieder, Sunderlin

Associate Professors: Allen, Brotherson, Cook, Dail, Garasky, Hegland, Herwig, McBride, K. Miller, N. Miller, Molgaard, Peterson, Ripple, Strong, Yearns

Associate Professors (Collaborators): Sellers

Assistant Professors: Bryant, Crull, Enders, Garcia, Graham, Kiss, McMurray-Schwarz, Thieman, Werner-Wilson

Assistant Professors (Adjunct): Colbert, Hendricks

Assistant Professors (Emeritus): Glass

Instructors (Adjunct): Jolly, Oesterreich, Walsh

Undergraduate Study

For undergraduate curricula in human development and family studies, leading to the degree bachelor of science, see *Family and Consumer Sciences, Curricula*.

The Department of Human Development and Family Studies offers courses that focus on the interactions among individuals, families, their resources, and their environments throughout the life span. The department offers work for the bachelor of science degree in four curricula: child and family services; family resource management and consumer sciences; housing and the near environment; and early childhood education.

At the completion of undergraduate study in Human Development and Family Studies, undergraduates will demonstrate knowledge and understanding of: a) family systems, including special populations, and their relationships to environments and institutions; b) life span development, including special populations; c) professionalism, ethics, and public policy issues for working with individuals and families, including special populations; d) personal and professional communication with children and families, including special populations; e) management of human and material resources for children and families, including special populations.

The child and family services curriculum leads to work in the helping services with employment opportunities in public and private agencies. Opportunities exist to observe and work with infants, preschoolers, school-age children, adolescents, the elderly, and families. Graduates of the program are prepared for employment in agencies and organizations serving children, families, and the elderly as program development specialists, coordinators, directors, and administrators. This flexible program provides a broad emphasis in theory, research, and application in child and family services including attention to community issues and public policy. A student may seek a double major or preprofessional preparation.

The family resource management and consumer sciences curriculum focuses on the behavior of families as they allocate and manage their resources and function as consumers. The curriculum leads to employment with agencies and organizations concerned with family financial management, financial counseling, consumer economics, and analysis and implementation of public policies that affect family resource management.

The curriculum in housing and the near environment focuses on housing needs, issues, and trends, such as housing alternatives for families and children; housing for the elderly and persons with disabilities; residential property management; and public policy. Graduates of this curriculum are prepared for employment in public and private (profit and not-for-profit) agencies and organizations; real estate and lending institutions; housing management and administration; the housing and furnishings industries; and housing advocacy.

The curriculum in early childhood education is planned for students preparing to teach young children and work with their families. This program leads to careers in working with young children who are typically developing and those with special needs from birth through age eight. Graduates in this curriculum may teach in early childhood (preschool and primary) classrooms or home based programs, with emphasis on inclusive services; graduates may be employed by either public or private agencies or schools. This curriculum has been approved by the Iowa Department of Education and meets requirements for the early childhood education unified teacher license, which permits individuals to teach general and special education for children from birth through age eight. The program is administered jointly by the Department of

Curriculum and Instruction within the College of Education and the Department of Human Development and Family Studies within the College of Family and Consumer Sciences.

The department offers minors in family resource management and consumer sciences, child and family services, and housing and the near environment. The department also offers journalism areas of concentration in child and family services, housing and the near environment, and family resource management and consumer sciences; see department for details.

The family resource management and consumer sciences minor may be earned by completing 15 credits in the following courses: 102, 283, 378, 395, 448, 483, 488, 489.

The child and family services minor may be earned by completing 102; selecting 3 credits from 378 or 449; selecting 3 credits from 220, 221, 226, or 377; selecting 3 credits from 276, 349, 360, 370, 373, or 378; and selecting 3 credits from 340, 343, 345, 395, 460 and 479.

The housing and the near environment minor may be earned by completing credits from the following courses: 317H, 341, 360, 416C, 460, 463, 490B.

An accredited program of study resulting in a Bachelor of Arts degree in Social Work is available through a collaborative arrangement between Iowa State University and the University of Iowa School of Social Work. ISU students need to complete their lower division requirements, Sociology 261, and 12 credit hours in a concentration like sociology, human development and family studies, or psychology. Then they may transfer to the University of Iowa for the upper division courses in Social Work which are available at both the University of Iowa School of Social Work's Des Moines Educational Center and the Iowa City campus. It is also possible for students to obtain a second bachelor's degree by combining a degree in child and family services from Iowa State University with a degree in Social Work from the University of Iowa. Interested students should see their department advisors for more specific individualized guidance.

English proficiency requirement: A student must achieve a grade of C or higher in English 104 and 105. A student achieving a grade of C- or lower in 104 and/or 105 must either repeat the course(s), earning a minimum grade of C, or, in consultation with the adviser and the coordinator of freshman English, complete another appropriate English writing course with a minimum grade of C.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with the major in human development and family studies, and minor work for students taking major work in other departments. Graduates of M.S. and Ph.D. programs in the department will understand and apply relevant theories to educational, research, and/or intervention programs. It is intended that they will produce and disseminate research results and

provide leadership in human development and family studies professions.

Within the major of human development and family studies students may choose from different specializations. Specializations are available for both M.S. and Ph.D. candidates in child development, early childhood education, early childhood special education, family policy, family studies, and life-span studies. Ph.D. candidates may also specialize in marital and family therapy. The marital and family therapy specialization is accredited by the Commission on Accreditation for Marriage and Family Therapy Education. The Department of Human Development and Family Studies offers coursework and experiences leading to National Council of Family Relations certification as a family life educator.

The department also participates in the Master of Family and Consumer Sciences degree by offering a specialization with that program.

The department cooperates in the interdepartmental minors in housing and gerontology.

Prerequisite to work in the major is the completion of a related undergraduate program with basic courses in one or more of the following areas: architecture, child/human development, community and regional planning, economics, education, family studies, interior design, psychology, or sociology. Additional prerequisites, if any, depend upon the area of specialization.

Guidelines for graduate programs of study in human development and family studies have been developed. However, the student's program of study committee has the major responsibility for determining requirements for an individual program.

Courses open for nonmajor graduate credit: 448, 449, 455, 456, 479, 483, 488, 489.

Courses Primarily for Undergraduate Students.

HD FS 102. Individual and Family Life Development. (3-0) Cr. 3. F.S.SS. Development of individuals, families, and their reciprocal relationships as affected by external factors; examined within a framework of life-span developmental tasks.

HD FS 210. Home Furnishings and Equipment for Consumers. (3-0) Cr. 3. F. Analysis of home furnishings and equipment needs. Emphasis on types, quality, safety, maintenance and resource utilization. Selection criteria for various lifestyles and populations with attention to maintaining health and comfort in institutional and residential settings.

HD FS 218. Human Development and Family Studies Study Tour. Cr. 1. F.S. Prereq: 102. Restricted to HD FS majors. The process of professional development and the scope of professional responsibilities in human development and family studies. Study of and visits to programs that serve children and families with diverse needs. Field trip fee. Offered on a satisfactory-fail grading basis only.

HD FS 220. Development and Guidance: Ages Birth through 2 Years. (2-2) Cr. 3. F.S. Alt. SS., offered 2000. Prereq: 102. Typical and atypical development from birth through two years of age. Development and guidance within the contexts of family, program, and society. Guided observation of physical, motor, cognitive, communication, social and emotional development; participation in an infant care center.

HD FS 221. Development and Guidance: Ages 3 through 8 Years. (2-2) Cr. 3. F.S. Alt. SS., offered

2001. Prereq: 102. Typical and atypical development from three through eight years of age. Development and guidance within the contexts of family, program, and society. Guided observation of physical, motor, cognitive, communication, social, and emotional development; participation in an accredited preprimary program.

HD FS 226. Development and Guidance in Middle Childhood. (2-2) Cr. 3. F.S.SS. Prereq: 102 or Psych 230. Developmental characteristics of children from 5 to 12 years of age. Development in the contexts of family, school, and society. Guidance of children in family and group settings. Directed observation and participation with children.

HD FS 239. Housing Environments for Children and Families. (3-0) Cr. 3. S. Introduction to housing environments emphasizing physical, cultural, economic, sociopsychological, and political conditions that affect the housing needs of children, individuals, and families. Factors related to differences in needs across the life span in a variety of settings. Study centered around housing context, housing structures, and housing finance.

HD FS 240. Literature for Children. (3-0) Cr. 3. F.S. Prereq: 102 or Psych 230. Evaluation of literature for children. Roles of literature in the total development of children. Literature selection and use.

HD FS 269. Research in Human Development and Family Studies. (3-0) Cr. 3. F.S.SS. Prereq: 102 or Psych 230. Understanding and evaluating research. Use of primary and secondary data to identify and study problems related to human development and family issues, including finance and housing. An introduction to statistical concepts and computer analysis. Research participation.

HD FS 276. Human Sexuality. (3-0) Cr. 3. F.S. Behavioral, biological, and psychological aspects of human sexuality within the social context of family, culture, and society. Role of sexuality in human development. Critical analysis of media and research. Communication and decision-making skills relating to sexuality issues and relationships.

HD FS 283. Family Financial Management. (3-0) Cr. 3. F.S.SS. Basic principles of money management. Budgeting, record keeping, checking and savings accounts, consumer credit, insurance, investment, taxes.

HD FS 317. Field Experiences. Cr. arr. F.S.SS. Consult department office for procedure. Supervised field experience in human development and family studies programs. May be repeated. Offered on a satisfactory-fail grading basis only.

- A. Early Childhood Education Programs. Prereq: 343, permission of instructor.
- B. Family Services Programs. Prereq: 9 credits in HD FS, permission of instructor.
- C. Early Childhood Special Education Programs. Prereq: 220, 221, permission of instructor.
- D. School-Age Child Care Programs. Prereq: 226, permission of instructor.
- E. Infant/Toddler Programs. Prereq: 340, permission of instructor.
- F. Research. Prereq: 269, permission of instructor.
- G. Family Resource Management Programs. Prereq: 283, permission of instructor.
- H. Housing Programs. Prereq: Permission of instructor.

HD FS 340. Assessment and Curricula: Ages Birth through 2 Years. (3-3) Cr. 4. F.S. Alt. SS., offered 2001. Prereq: 220. Assessment strategies for infants and toddlers, including those with special needs. Curricula, learning environments, teaching strategies, health and nutritional practices, and schedules that are developmentally, individually, and culturally appropriate. Using assessment to plan, implement, and evaluate activities to promote physical, motor, cognitive, communication, and social emotional development.

HD FS 341. Housing Finance and Policy. (3-0) Cr. 3. F. Prereq: 6 credits in social sciences. Personal and family financial considerations in home ownership, rental, and home improvements. The social, economic, and governmental contexts of financial decision-

making at the household level. Financial considerations for residential property management.

HD FS 343. Assessment and Programming: Ages 3 through 6 Years. (3-3) Cr. 4. F.S. Alt. SS., offered 2000. *Prereq:* 221; 240; 345; 269 or Psych 333. Assessment strategies for preschool and kindergarten children, including those with special needs. Learning environments, schedules, activities, nutritional practices, and teaching strategies that are developmentally, individually, and culturally appropriate. Using assessment to plan, implement, and evaluate activities to promote physical motor, cognitive, communication, and social emotional development.

HD FS 345. Adapting Programming in Inclusive Settings. (3-0) Cr. 3. F.S. *Prereq:* 343; Sp Ed 250. Adapting materials and equipment to meet social, cognitive, nutritional, physical motor, communication, and medical needs of children, birth through 8, with diverse learning needs and multiple disabilities in inclusive settings for young children. Appraisal and management of specialized health care needs. Designing and evaluating individual education plans; supervising paraprofessionals in educational settings.

HD FS 349. Parenting and Family Diversity Issues. (3-0) Cr. 3. F.S. *Prereq:* *Sophomore classification.* Diversity issues as they affect families. Parenting practices and family relationships across cultures. Topics include: Gender differences, disabilities, adoption, and diverse family composition. Understanding of the family system and the relationship of that system to societal systems.

HD FS 360. Housing and Services for Families with Special Needs. (3-0) Cr. 3. S. *Prereq:* 6 credits in social sciences. Housing and service alternatives that assist families and individuals with special needs, including the disabled, the homeless, low income, and single parents. Residential property management considerations for families with special needs. Experimental and innovative approaches to housing and services. Field trip fee.

HD FS 367. Abuse in Families. (3-0) Cr. 3. S. Alt. SS., offered 2000. *Prereq:* 9 credits in social sciences. Causes and consequences of physical, sexual, and emotional abuse in families across the life cycle. Interplay between victims, offenders, and the treatment system.

HD FS 370. Communication in Human and Family Development. (3-0) Cr. 3. F.S. Alt. SS., offered 2001. *Prereq:* 3 credits in social sciences. Application of communication processes in human and family development. Development, maintenance, enrichment, and change in family, personal, and professional relationships through the life span.

HD FS 373. Death as a Part of Living. (3-0) Cr. 3. F.S. Alt. SS., offered 2000. *Prereq:* 102. Consideration of death in the life span of the individual and the family with opportunity for exploration of personal and societal attitudes. Field trip fee.

HD FS 377. Aging and the Family. (Same as Geron 377.) (3-0) Cr. 3. F. Alt. SS., offered 2001. *Prereq:* 102. Interchanges of the aged and their families. Emphasis on role changes, social interaction, and independence as influenced by health, finances, life styles, and community development.

HD FS 378. Family and Management Patterns. (3-0) Cr. 3. F.S. *Prereq:* 102 or Soc 134. The use of systems theory and family development theory in understanding family behavior, including the management of family resources across the family life cycle to achieve family goals.

HD FS 380. Family Law. (3-0) Cr. 3. F.S. *Prereq:* *Junior classification.* Family relationships, rights, and duties as prescribed by law. Investigation of sources and interpretations of law. Materials fee.

HD FS 381. International Study in Human Development and Family Studies. (Dual-listed with 581.) Cr. Arr. May be repeated. F.S.SS. *Prereq:* *Permission by application.* Limited enrollment. Supervised international study experiences in Human Development and Family Studies. Countries vary. Field trip fee.

- A. Practicum
- B. Exchange
- C. Group Study

HD FS 395. Children, Families, and Public Policy. (3-0) Cr. 3. F.S. *Prereq:* 6 credits in social sciences. Public policy and politics as they affect children and families. Examination of how individuals and groups influence policy. Investigation of current issues and programs influencing the well-being and welfare of children and families.

HD FS 416. Human Development and Family Studies Seminar. Cr. var. May be repeated. F.S.SS. *Prereq:* 8 credits in human development and family studies. Intensive study of a selected topic in human development and family studies.

HD FS 417. Supervised Student Teaching. Cr. 8. Reservation required.

B. **Preschool Programs.** F.S. *Prereq:* GPA 2.5; full admission to teacher education program, 455.

Teaching experience with young children from birth to 5 in group settings.

C. **Early Childhood Special Education Programs.** F.S. *Prereq:* GPA 2.5; full admission to teacher education program, 455, enrollment in C I 417. Teaching experience with preschool children with disabilities.

HD FS 437. Characteristics of Giftedness. (Dual-listed with 537; same as Psych 437.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 9 credits in human development and family studies or psychology, including Psych 230 or HD FS 102: junior classification. Understanding of giftedness and talent from cognitive, developmental, and social perspectives using a life-span approach. Current conceptualizations and research regarding gifted children and adults. Implications for education and guidance.

HD FS 445. Administration of Programs for Children. (3-0) Cr. 3. S. *Prereq:* 340 or 343. Management principles and techniques, including an introduction to financial management, involved in programs for children with diverse needs and their families. Staff development, supervision, and evaluation in programs for children and families. Government regulations concerning child and family programs; community relations; and advocacy for children and families.

HD FS 448. Economics of Aging. (Same as Geron 448.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 3 credits in principles of economics, 3 credits in human development and family studies. Economic status of the aging; retirement planning and the retirement decision; role of Social Security; public transfer programs for the elderly; intrafamily transfers to/from the elderly; private pensions; financing medical care and housing for the elderly; prospects and issues for the future. Nonmajor graduate credit.

HD FS 449. Linking Families and Communities. (3-0) Cr. 3. F.S. *Prereq:* 269 or Psych 333. Assessing family needs and community resources across the lifespan. Characteristics of successful community based family intervention and support programs. Strategies and skills needed by community based professionals, including educators. Linking families to community resources. Nonmajor graduate credit.

HD FS 455. Curricula for Ages 3 through 6 Years. (3-3) Cr. 4. F.S. *Prereq:* 343, 345. Program models and methods leading to development and organization of appropriate curricula in preschool and kindergarten programs, for young children with diverse learning needs. Government regulations and professional standards for child programming. Teaming with parents, colleagues, and paraprofessionals to plan, implement, and evaluate developmentally and culturally appropriate individualized education plans in inclusive settings. Integrated practicum setting. Nonmajor graduate credit.

HD FS 456. Family-Focused Interventions for Young Children. (3-1) Cr. 3. F.S. *Prereq:* 340, 345. Application of family systems theory in family-focused service delivery models. Teaming with parents and colleagues to plan, implement, and evaluate individualized family service plans. Focus on home-based intervention using routines and activities to embed intervention goals, family support, and linking families to community resources. Field experience in home-based programs. Nonmajor graduate credit.

HD FS 460. Housing and Environments for Children. (Dual-listed with 560.) (3-0) Cr. 3. F. *Prereq:* 6 credits in architecture, art and design, edu-

cation, interior design, human development and family studies, psychology. Assessment of environments for children including home, child care, school, and community settings. Emphasis on design of developmentally appropriate settings that foster independence for children with and without disabilities.

HD FS 463. Housing and Environments for the Elderly. (Dual-listed with 563; same as ArtID 463, Geron 463.) (3-0) Cr. 3. S. *Prereq:* 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies. Emphasis on independent living within residential settings. Specialized shelter and supportive services and managerial processes for persons who are elderly and/or disabled. Application of criteria appropriate for accessibility and functional performance of activities. Work with professionals to plan and evaluate special projects. Field trip. Materials fee.

HD FS 479. Family Interaction Dynamics. (3-0) Cr. 3. F. *Prereq:* 378. Analysis of family interaction processes and patterns with emphasis on relationship dynamics across the family life span. Nonmajor graduate credit.

HD FS 483. Advanced Family Financial Management. (3-0) Cr. 3. F.S. *Prereq:* 283. Managerial approaches to achievement of short- or long-term financial goals for households. Investigation of different forms of investments and investment risks management in financing current and future consumption. Analyses of tax, estate, and retirement planning needs of the family. Nonmajor graduate credit.

HD FS 488. Family in the Economy. (3-0) Cr. 3. S. *Prereq:* Econ 101. Analysis of the family as an economic unit in society. Structure and composition of the family. Patterns of resource use and activities pursued by the family. Family economic transitions such as marriage, divorce, and childbirth. Nonmajor graduate credit.

HD FS 489. Family Financial Counseling. (Dual-listed with 589.) (3-0) Cr. 3. F. *Prereq:* 483. Personal, social/psychological, and legal climates affecting family financial decisions. A life-cycle approach to financial decision-making. Development of financial counseling and planning skills to assist families and individuals to become self-sufficient in family financial management. Nonmajor graduate credit.

HD FS 489L. Laboratory in Family Financial Counseling. (0-2 or 0-4) Cr. 1-2. May be repeated. F.S. *Prereq:* 489. Experience in remedial, preventive, and productive financial counseling.

HD FS 490. Independent Study. Cr. arr. *Prereq:* 6 credits in human development and family studies. Consult department office for procedure.

- A. Child and Family Studies
- B. Housing
- C. Family Resource Management
- F. Early Childhood Education
- G. Early Childhood Special Education
- H. Honors
- I. Human Development and Family Studies
- R. Research

HD FS 491. Practicum. Cr. 4 or 8. May be repeated. F.S.SS. Arr. *Prereq:* 449; permission of instructor. Reservation required one semester before placement; minimum 2.0 GPA. Supervised work experience off campus related to the student's curriculum. Offered on a satisfactory-fail grading basis only.

HD FS 493. Workshop. (Dual-listed with 593.) Cr. arr. May be repeated. F.S.SS. *Prereq:* Senior classification.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

HD FS 500. Short Course. Cr. arr. May be repeated. *Prereq:* Permission of instructor. Concentrated group study of various developmental and educational issues in the field of human development and family studies.

HD FS 501. Graduate Study Orientation. (1-0) Cr. R. F. Orientation to graduate study and current research in the department.

HD FS 502. Theories of Human Development and Family Studies. (3-0) Cr. 3. F.SS. *Prereq:* 6 credits of social sciences. Theoretical approaches and current research in child, adolescent, adult, and family development. Family systems, individual life span, and family life-cycle perspectives.

HD FS 503. Research Methods in Human Development and Family Studies. (3-3) Cr. 4. S. *Prereq:* Stat 401 or ResEv 553. Concepts, methods, and strategies for research in human development and family studies. Topics include the nature of scientific research, measurement, types of research in human development and family studies, validity of research designs, methods of data gathering, and strategies for and issues in the study of change. Coding, entry, and manipulation of research data. Practical applications with interactive statistical software.

HD FS 521. Housing and the Social Environment. (Same as Hous 521.) (3-0) Cr. 3. S. *Prereq:* Graduate classification; 502 or 6 credits in social sciences. Housing adjustment behavior of individuals and families in the context of the social and cultural framework of society. Analysis of conceptual frameworks, methodological approaches, and current research in housing. Impact of housing on the family.

HD FS 523. Household Resource Development and Allocation. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 378, 6 credits in sociology or economics. Theories and research in goal-oriented behavior. Emphasis on the fit between household behavior in resource allocation and policies designed to foster or inhibit such behavior.

HD FS 525. Theories and Research in Early Childhood Education. (3-0) Cr. 3. S. *Prereq:* 502 or 6 credits in social sciences. Analysis of contemporary and historical models, including early intervention programs. The effect of variables such as programming, physical environment, and teacher effectiveness on children. Research on teacher-child and teacher-parent interactions in early childhood education programs.

HD FS 534. Adult Development. (Same as Geron 534.) (3-0) Cr. 3. S. *Prereq:* 502. Adult development of cognition, personal characteristics, and cultural aspects of human relationships. Emphasis on development and psychosocial health in young, middle, and later adulthood.

HD FS 537. Characteristics of Giftedness. (Dual-listed with 437; same as Psych 537.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 9 credits in human development and family studies or psychology, including Psych 230 or HD FS 102; junior classification. Understanding of giftedness and talent from cognitive, developmental, and social perspectives using a life-span approach. Current conceptualizations and research regarding gifted children and adults. Implications for education and guidance.

HD FS 538. Developmental Disabilities in Children. (Same as Psych 538.) (3-0) Cr. 3. S. *Prereq:* 9 credits in human development and family studies or psychology. Theories, research, and current issues regarding development in children with disabilities. Investigation of interventions with children and families.

HD FS 547. Parent-Child Relations. (3-0) Cr. 3. F. *Prereq:* 502 or 6 credits in social sciences. Analysis of theories and research related to parent-child interactions; examination of parenting as a developmental process. Current issues in child rearing.

HD FS 548. Parent Education. (3-0) Cr. 3. S. *Prereq:* 502 or 6 credits in social sciences. Needs assessments, models, delivery systems, and evaluation procedures used in parent education programs for families with diverse needs, including single parents, adolescent parents, and parents of children with developmental disabilities. Developmental aspects of parenting. Effects of values, family structures, family goals, and parenting styles on parent education.

HD FS 555. Advanced Issues and Program Planning in ECSE. (3-1) Cr. 3. Alt. SS., offered 2001. *Prereq:* 9 credits in social sciences. Curriculum issues in early childhood special education including inclusion, activity-based intervention, and develop-

mentally appropriate programming. Emphasis on continuum of strategies to promote peer interactions. Lab participation in integrated classroom.

HD FS 556. Families and Disability. (3-0) Cr. 3. S. *Prereq:* 9 credits in social sciences. Review of research, policy, and practice regarding families with children who are disabled. Educational, environmental, economic, and social issues faced by families. Communication and consultation skills to work collaboratively with interdisciplinary professionals and families to implement individualized family and educational programs.

HD FS 560. Housing and Environments for Children. (Dual-listed with 460; same as Hous 560.) (3-0) Cr. 3. F. *Prereq:* 6 credits in architecture, art and design, education, interior design, human development and family studies, or psychology. Assessment of environments for children including home, child care, school, and community settings. Emphasis on design of developmentally appropriate settings that foster independence for children with and without disabilities.

HD FS 563. Housing and Environments for the Elderly. (Dual-listed with 463; same as Geron 563, Hous 563.) (3-0) Cr. 3. S. *Prereq:* 360 or 3 credits in housing, architecture, interior design, rehabilitation, psychology, or human development and family studies. Emphasis on independent living within residential settings. Specialized shelter and supportive services and managerial processes for persons who are elderly and/or disabled. Application of criteria appropriate for accessibility and functional performance of activities. Work with professionals to plan and evaluate special projects. Field trip. Materials fee.

HD FS 566. Impact of Public Policy on the Family. (3-0) Cr. 3. S. *Prereq:* 9 credits in social sciences. The effect of legislative policy on the family. Explicit and implicit family policies in other nations contrasted with policies affecting American families. Specific legislation analyzed by family impact analysis.

HD FS 567. Family Violence. (3-0) Cr. 3. F. *Prereq:* 9 credits in social sciences. Contemporary theory and research in family violence. Emphasis on societal and interpersonal factors that influence intrafamilial abuse. Implications for intervention and public policy.

HD FS 568. Developmental Assessment. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 502. Procedures and issues related to developmental assessment of young children. Emphasis on developing and implementing play-based processes for assessing development of young children. Focus on collaboration with families and using assessment information for planning interventions.

HD FS 570. Families Across the Life Span. (3-0) Cr. 3. F. *Prereq:* 9 credits in social sciences. Theory and research in development and change in family systems and in their reciprocal relationships with the individual and the environment across the family life span.

HD FS 571. Marital and Family Intervention. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 12 credits in social sciences. Survey of marital and family therapy approaches to individual and family problems with primary attention on transgenerational and experiential theories and techniques.

HD FS 572. Stress and Family Crisis. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 9 credits in social sciences. Introduction to family stress theory, vulnerability, and coping research. Emphasis on practical application of theoretical concepts.

HD FS 573. Ethics and Professional Studies in Marriage and Family Therapy. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 571. Professional ethics and family law relevant to family therapy; review of professional organizations, private practice, and grant writing.

HD FS 575. Cross-cultural Perspectives on Families and Children. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 6 credits in social sciences. Review of methods and findings on cultural influences on the development of children and youth and on family life. Comparison of child rearing practices, family roles, values, and traditions in different cultures.

HD FS 577. Aging and Intergenerational Relations. (Same as Geron 577.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 9 credits in social sciences. Theories and research related to personal and family adjustments in later life affecting older persons and their intergenerational relationships. Related issues including demographics are also examined through the use of current literature.

HD FS 579. Theories and Research in Family Studies. (3-0) Cr. 3. S. *Prereq:* 9 credits in social sciences. Current research and theoretical perspectives in family studies, including family dynamics, family and change, and family problems.

HD FS 580. The Family and the Law. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 6 credits in social science. The effects of selected legislation and cases on individuals and families. The legal processes involved in the activities of individuals and families. Implications for effective functioning within the limits of the legal environment. Legal and quasi-legal services available in the community. Field trip fee.

HD FS 581. International Study in Human Development and Family Studies. (Dual-listed with 381.) Cr. Arr. May be repeated. F.S.SS. *Prereq:* Permission by application. Limited enrollment. Supervised international study experiences in Human Development and Family Studies. Countries vary. Field trip fee.
A. Practicum
B. Exchange
C. Group Study

HD FS 585. Family Policy Analysis. (3-0) Cr. 3. F. *Prereq:* 6 credits in graduate level social sciences. Theoretical and practical issues related to family policy program evaluation. Assessment of programs' success in meeting goals. Examination of concepts related to family policy development in the United States. Examination of how individuals and groups can influence family policy and evaluation.

HD FS 588. Family Economics and Public Policy. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 6 credits in sociology and economics. Analysis of family income, wealth, and economic well-being. Emphasis on effects of family behavior and public policies on the adequacy and security of income across the family life cycle. Implications of resource allocation within the family for adult and child well-being.

HD FS 589. Family Financial Counseling. (Dual-listed with 489.) (3-0) Cr. 3. F. *Prereq:* Graduate classification. Personal, social/psychological and legal climates affecting family financial decisions. A life cycle approach to financial decision making. Development of financial counseling and planning skills to assist families and individuals to become self-sufficient in family financial management.

HD FS 590. Special Topics. Cr. arr. *Prereq:* Permission of instructor. Consult department office on procedure for filing a written plan of study.

- A. Family Studies
- B. Housing
- C. Family Resource Management
- D. Human Development
- E. Child Development
- F. Early Childhood Education
- G. Early Childhood Special Education
- I. Human Development and Family Studies
- M. Marital and Family Therapy

HD FS 591. Practicum. Cr. arr. May be repeated. F.S.SS. *Prereq:* 10 graduate credits. Supervised experience in an area of human development and family studies.

- A. Family Studies
- B. Housing
- C. Family Resource Management
- D. Human Development
- E. Child Development
- F. Early Childhood Education
- G. Early Childhood Special Education
- I. Human Development and Family Studies
- M. Marital and Family Therapy

HD FS 593. Workshop. (Dual-listed with 493.) Cr. arr. May be repeated. F.S.SS. *Prereq:* Senior classification.

Courses for Graduate Students

HD FS 602. Advanced Theories of Human Development and Family Studies. (3-0) Cr. 3. F. *Prereq:* 502, 503. Current advanced theories and perspectives in human development and family studies. Topics include theory construction and evaluation, advanced life-span theories, longitudinal approaches, advanced family theories and socio-historical perspectives.

HD FS 603. Advanced Quantitative Methods. (3-0) Cr. 3. S. *Prereq:* 503; *Stat 402, 403, or 404.* Methodological and analytical issues in research in human development and family studies. Advanced research design and measurement, selection of statistical techniques, and issues in the interpretation of findings.

HD FS 604. Advanced Qualitative Research. (3-0) Cr. 3. F. *Prereq:* 503. An advanced qualitative research methods course that builds on 503. Qualitative methods and related theory commonly used by researchers in family therapy, human development, and family studies. Epistemology, grounded theory, ethnomethodology, hermeneutics, oral life stories, and content analysis.

HD FS 616. Seminar. Cr. arr. May be repeated. F.S.SS.

HD FS 631. Learning and Cognitive Development in Children. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 502. Theory and research emphasizing constructivist, Vygotskian, and information processing approaches to cognitive development. Concept, memory, and problem-solving development. Sources of individual differences in cognitive functioning of children and adolescents.

HD FS 632. Language and Perceptual Development in Children. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 502. Models of perceptual development. Research methods and findings. Theories and research on language development. Role of perceptual strategies in the language learning process.

HD FS 633. Social and Emotional Development in Children. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 502. Theory and research related to social and emotional development of infants, children, and adolescents. Dynamic socialization processes involving children, adolescents, parents, peers, and society.

HD FS 634. Adolescent Development. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 502, 503. Theory and research on physical-motor, intellectual-cognitive, and social-personality development from early to late adolescence. Sources of developmental and individual differences in identity formation and attainment.

HD FS 650. Advanced Family Policy Theory. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 588. Analysis of theories, research, and current issues related to family and household economics and policy. Emphasis on theory development and empirical analyses of macro and micro family economic problems. Future policy, economic and social trends, and their meaning for the family as an economic institution.

HD FS 672. Marital Therapy. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 12 graduate credits in social sciences. Theories and techniques of marital therapy across the life cycle.

HD FS 673. Interactional and Systemic Family Therapy. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 571, 672. An in-depth review of the Interactional (MRI) and Systemic (Milan) models of family therapy. Also reviews similar models based on these two pioneer approaches. Application of models in clinical practice.

HD FS 674. Structural and Strategic Family Therapy. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 571 or 672. Application of structural and strategic models of family therapy in clinical practice.

HD FS 676. Family Therapy. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 571. Application of family and counseling theory to the process of therapeutic intervention with families. Emphasis on systems dynamics throughout the family life cycle.

HD FS 679. Cybernetics of Cybernetics. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 676. Constructivism as

a theoretical paradigm. Second order cybernetics and language systems as metaphors for therapeutic practice.

HD FS 690. Advanced Topics. Cr. arr. *Prereq:* *Permission of instructor and enrollment in Ph.D. program.*

- A. Family Studies
- B. Housing
- C. Family Resource Management
- D. Human Development
- E. Child Development
- F. Early Childhood Education
- G. Early Childhood Special Education
- I. Human Development and Family Studies
- M. Marital and Family Therapy

HD FS 691. Internship. Cr. arr. May be repeated. F.S.SS. *Prereq:* *Permission of instructor.* Offered on a satisfactory-fail grading basis only. Supervised practice and experience in the following specified areas:

- A. College Teaching
- B. Research
- C. Marital and Family Therapy

HD FS 692. Family Therapy Supervision. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 691C. Preparation of marital and family therapy supervisors.

HD FS 699. Research. Cr. arr. Offered on a satisfactory-fail grading basis only.

- A. Family Studies
- B. Housing
- C. Family Resource Management
- D. Human Development
- E. Child Development
- F. Early Childhood Education
- G. Early Childhood Special Education
- I. Human Development and Family Studies
- M. Marital and Family Therapy

Immunobiology

(Interdepartmental Graduate Major)

Supervisory Committee: R. Rosenbusch, *Chair;* S. J. Lamont, J. E. Buss, S. L. Carpenter, J. Harp, H. Moon

The Graduate Faculty: Mark Ackerman, Amy Andreotti, Clare Andreson, Jan Buss, Susan Carpenter, Norman Cheville, Joan Cunnick, Ronald Griffith, James Harp, Hank Harris, Julie Jarvinen, Merlin Kaeberle, Marcus Kehrl, Ted Kramer, Susan Lamont, F. Chris Minion, Harley Moon, Brian Nonneke, Evelyn Nystrom, Prem Paul, Ken Platt, Don Reynolds, Ricardo Rosenbusch, Richard Ross, James Roth, Max Rothschild, Randy Sacco, Mary Schmerr, Louisa Tabatabai, Eileen Thacker, Charles Thoen, Mike Wannemuehler

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in Immunobiology. Faculty are drawn from five departments: Animal Science; Biochemistry, Biophysics, and Molecular Biology; Microbiology; Veterinary Microbiology & Preventive Medicine; and Veterinary Pathology. The diversity of faculty expertise ensures a broad education, while offering flexibility in choice of specialization. Ongoing research projects include areas such as: antibody and cell-mediated immunity, immunochemistry, immunogenetics, immunomodulation, mucosal immunity and nutritional immunology.

Students may enter the Immunobiology major in one of two ways; they may apply to and be directly accepted into the major, or they may be admitted to a participating department followed by formal admission to the major. Students directly admitted into the Interdepartmental Immunobiology Major will take Imbio 697 (graduate research rotation) in their first two semesters, and by the end of the second semester, enter a department by choosing a major professor from the participating faculty. Students first admitted to a department will choose a major professor from the participating faculty in that department.

Students should have a strong background in the biological sciences, including work in immunology, genetics and biochemistry. Prior research experience is highly encouraged. Submission of scores of the GRE General Test is required.

Immunobiology students should include in their program of study a core of courses which will provide a broad coverage of the basic program in immunobiology. Formal courses should include immunology, biochemistry, and statistics. Additional coursework may be selected to satisfy individual interests or departmental requirements. The foreign language and teaching requirements are determined by the student's department. All students will take a minimum of one seminar course per year.

Graduates have a broad understanding of the interdisciplinary field of immunobiology, and can effectively integrate the principles of immunology with related disciplines. They are able to effectively communicate with scientific colleagues and the general public in both formal and informal settings. Graduates are able to integrate theory and research to address complex problems facing scientific professionals studying animal and human health, taking into account related ethical, social, legal and environmental issues. They are skilled at carrying out research, communicating research results, and writing persuasive grant proposals.

Courses for Graduate Students

Imbio 604. Seminar in Immunobiology. (1-0) Cr. 1 each time taken. Student and faculty presentation.

Imbio 690. Special Topics. Cr. var. each time taken. Advanced study of specific topics in specialized field of immunobiology.

Imbio 697. Graduate Research Rotation. Cr. Var, each time taken. Graduate research projects performed under the supervision of selected faculty members in the Interdepartmental Immunobiology major.

Imbio 699. Research.

Industrial Engineering

(Administered by the Department of Industrial and Manufacturing Systems Engineering)

Pius J. Egbelu, Chair of Department

Professors: Barta, Berger, Egbelu, Heising, Morris, Vardeman

Distinguished Professors (Emeritus): Cowles

University Professors (Emeritus): David

Professors (Emeritus): Even, Griffen, Hempstead, Kleinschmidt, McRoberts, Mohr, Montag, Moore, C. Smith, G. Smith, Squires, Tamashunas, Vaughn, Walkup

Associate Professors: Adams, Day, Gemmill, Jackman, Meeks, Min, Patterson

Associate Professors (Emeritus): Love

Assistant Professors: Narayanaswami, Olafsson, Peters, Van Voorhis

Assistant Professors (Adjunct): Moller-Wong

Undergraduate Study

For the undergraduate curriculum in industrial engineering leading to the degree bachelor of science, see *College of Engineering, Curricula*. This curriculum is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

Industrial engineers are employed to improve systems and processes found in manufacturing, consulting, and service industries. Professional responsibilities are typically in design, management, analysis, optimization, and modeling of industrial systems. An industrial engineer is focused on human factors, operations research, manufacturing engineering, and quality. Industrial engineers are typically found in organizations responsible for operations management, process engineering, automation, logistics, supply chain management, scheduling, plant engineering, quality control, and technical sales.

The goal of the industrial engineering undergraduate curriculum is to produce technically qualified industrial engineers who are capable of successful professional practice in the field. Graduates of the program will be able to work effectively with other members of the work force to accomplish engineering advances in their assigned areas. The program also provides graduates with the necessary educational foundation to pursue advanced studies in industrial engineering or related fields.

Graduates of the program must demonstrate the ability to design, develop, implement and improve systems that include people, materials, information, equipment and energy. The program includes in-depth instruction to accomplish the integration of systems using appropriate analytical, computational and experimental practices.

In addition to the College of Engineering goals, the industrial engineering curriculum has the following goals for each student.

1. Students should be able to design, analyze, and manage effective manufacturing and service systems.
2. Students should be able to bridge the engineering and business functions of an organization.
3. Students should be able to integrate functions involving people, material, equipment, information, and control.
4. Students should have a global perspective of enterprise.
5. Students should be able to provide leadership in multi-functional teams.

The industrial engineering undergraduate curriculum provides students with fundamental knowledge in mathematics and science, engineering science, social science and humanities as well as professional industrial engineering course work. Management electives provide students with an opportunity to become familiar with modern business practices that they will encounter in their career. A senior capstone design course provides students with an opportunity to solve open-ended industrial problems with an industrial partner. The cooperative education program provides students with real world experience in the profession and good perspective on career choices. Students are encouraged to participate in international experiences through exchange programs and industrial internships.

Graduate Study

The department offers work leading to the degrees of master of engineering, master of science, and doctor of philosophy with a major in industrial engineering. A formal minor is available to doctor of philosophy students having a major in another department. Graduate study is designed to improve the student's capability in the professional practice of industrial engineering and to develop research ability.

The prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this institution.

With the help of a program of study committee, a graduate student develops an educational program in areas within industrial engineering. Typical areas of concentration include engineering economy; systems analysis and control, manufacturing systems analysis, manufacturing processes, production systems analysis and design, life cycle analysis and depreciation, operations research and optimization, and the human machine interface. A major in operations research leading to a master of science degree is co-offered with the Department of Statistics.

Courses open for nonmajor graduate credit: 304, 312, 313, 341, 348, 361, 375, 419, 436, 441, 443, 448, 461, 462, 465, 471, 476.

Courses Primarily for Undergraduate Students

IE 101. Orientation. (1-0) Cr. R. S. Introduce stu

dents to the industrial engineering profession, its scope, industrial engineering tools, and future trends.

IE 248. Introduction to Manufacturing Processes and Specifications. (2-2) Cr. 3. F.S. Prereq: Concurrent enrollment in Mat E 271. Theory, applications, and quality issues related to machining and other nontraditional material removal processes. Introduction to metrology, engineering drawings and specifications.

IE 271. Applied Ergonomics and Work Design. (3-3) Cr. 4. F.S. Prereq: Phys 221. Basic concepts of ergonomics and work design. Their impact on worker and work place productivity and cost. In-depth investigations of work physiology, biomechanics, anthropometry, work methods, and their measurement as they relate to person-machine systems.

IE 298. Cooperative Education. Cr. R. F.S.SS. Prereq: Permission of department chair. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

IE 304. Analysis for Engineering Economy. (2-0) Cr. 2. F.S. Prereq: Junior classification, Com S 205 or Engr 160, Math 166. Engineering/managerial analysis of the economic aspects of public and private project proposals. Decisions involving the expenditure of capital funds. Alternative sources of funds; time value of money; methods of evaluating alternative projects. Credit for either 305 or 304 may be applied toward graduation, but not both. Nonmajor graduate credit.

IE 305. Engineering Economic Analysis. (3-0) Cr. 3. F.S. Prereq: Math 166. Analysis of economic decisions related to planning, developing, and managing engineering projects. Time value of money; evaluating alternative projects; decision involving capital expenditures in private and public sectors.

IE 312. Optimization. (3-0) Cr. 3. F.S. Prereq: Math 266. Concepts, analysis techniques, optimization techniques, and applications of operations research. Construction and optimization of mathematical models for systems using linear programming and goal programming plus post optimality for evaluation results. Nonmajor graduate credit.

IE 313. Stochastic Analysis. (3-0) Cr. 3. F.S. Prereq: Math 266, Stat 231. Development of basic queuing models and related applications. Use of simulation for some applications. Project involving data collection analysis of a queuing system is required. Nonmajor graduate credit.

IE 341. Material and Project Control. (3-0) Cr. 3. F.S. Prereq: 312, Stat 231. Forecasting, analysis of inventory systems and sequencing and scheduling problems in the control of material flow with applications in industrial systems. Material requirement planning and project control techniques such as PERT and PERT/COST systems are included. Construction of mathematical models, use of heuristic techniques, and use of problem-oriented languages such as FORTRAN in solving problems. Project involving design of material control systems required. Nonmajor graduate credit.

IE 348. Solidification Processes. (2-2) Cr. 3. F.S. Prereq: IE 248. Theory, applications, and quality issues related to metal casting, welding, polymer processing, and other solidification processes. Use of CAD and process modeling software.

IE 361. Quality Control. (Same as Stat 361.) (3-0) Cr. 3. F.S. Prereq: Stat 231 or 401. Techniques for controlling the quality of products and services. Techniques for improving quality through process control. Project involving design of quality system. Nonmajor graduate credit.

IE 375. Introductory Production Systems. (3-0) Cr. 3. F.S. Prereq: Junior classification, Math 160 or 166. Principles and concepts in the design and control of production systems, including demand forecasting, fixed and variable capacity planning, master production scheduling, inventory control, types of production and work flow systems, quality control, and work methods and measurement. Nonmajor graduate credit.

IE 396. Summer Internship for International Students. Cr. R. S.S. *Prereq:* *Permission of department.* Summer professional work period for international students.

IE 397. Engineering Internship. Cr. R. F.S. *Prereq:* *Permission of department chair.* One semester maximum per academic year professional work period.

IE 398. Cooperative Education. Cr. R. F.S.S.S. *Prereq:* *Permission of department chair; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

IE 408. Interdisciplinary Problem Solving. (Same as BusAd 408, E E 408, I Tec 408.) (3-0) Cr. 3. F.S. *Prereq:* *Junior or senior standing.* Use the Theory of Constraints as a way of approaching problem solving, win-win negotiation, project planning and effective delegation in the context of engineering/business systems. Team projects are aimed at improving design outcomes. Nonmajor graduate credit.

IE 409. Interdisciplinary Systems Effectiveness. (Same as BusAd 409, E E 409, I Tec 409.) (3-0) Cr. 3. F.S. *Prereq:* *Junior or senior standing.* Focus on functions that determine the effectiveness of an entire organization. Generic Theory of Constraints solutions to production, distribution, project management are compared to traditional solutions. Strategy for improvements discovered using simulations and group projects. Nonmajor graduate credit

IE 419. Manufacturing Systems Modeling. (3-0) Cr. 3. F.S. *Prereq:* 313. Modeling material handling systems, inventory systems, and production systems for performance analysis. Introduction to analysis, simulation, and physical models of manufacturing systems. Simulation languages including ARENA, and SLAM. Nonmajor graduate credit.

IE 436. Introduction to Reliability Engineering. (3-0) Cr. 3. S. *Prereq:* *Senior classification, Stat 231 or 401.* Mathematical basics for dealing with reliability data, theory and analysis of load and strength, and systems reliability prediction methods to assure reliably designed systems. Reliability demonstrations and reliability growth monitoring. Fault tree and event tree analysis. Nonmajor graduate credit.

IE 439. Manufacturing Systems Control. (2-3) Cr. 3. S. *Prereq:* *E E 441.* Programming and interfacing microcomputers for communications and control. Algorithms, control circuits, and software for machine control and shop floor control.

IE 441. Industrial Engineering Design. (1-6) Cr. 3. F.S. *Prereq:* 271, 305, 312, 313, 348. A large, open-ended design project related to industrial systems. Application of engineering design principles including problem definition, analysis, synthesis, and evaluation. Nonmajor graduate credit.

IE 443. Material Handling and Automation. (3-0) Cr. 3. F.S. *Prereq:* 312, 313, and 348. Analysis and application of material handling systems and facility layouts. Application of sensors, PLCs and other automation devices to material handling systems. Cellular manufacturing, focused factories and other manufacturing system strategies. Nonmajor graduate credit.

IE 448. Manufacturing Systems Engineering. (3-0) Cr. 3. F.S. *Prereq:* 443. Control of manufacturing processes, process planning, geometric tolerancing, tooling requirements, make versus buy decisions, cellular and flexible manufacturing, computer aided inspection, and usage of CAD/CAM and robotics. Nonmajor graduate credit.

IE 449. Computer Aided Design and Manufacturing. (2-2) Cr. 3. F.S. *Prereq:* 348. Representation and interpretation of curves, surfaces and solids. Manual and automated programming for computer numerical control of machining, inspection, assembly and robotics. Nonmajor graduate credit.

IE 461. Quality Engineering. (3-0) Cr. 3. F. *Prereq:* 361. Analysis and design of quality engineering systems. Economic, statistical, and human aspects of quality. Analysis of engineering data for process improvement. Quality improvement projects, interacting with industry. Nonmajor graduate credit.

IE 462. Engineering Metrology. (2-3) Cr. 3. S. *Prereq:* 348, Stat 231. Measurement techniques and equipment used to evaluate product geometry created by manufacturing processes. Hard gaging, soft gaging, standards, the role of tolerances, and instrumentation. Nonmajor graduate credit.

IE 465. Knowledge Engineering. (2-3) Cr. 3. F. *Prereq:* *Stat 231.* Introduction to knowledge-based systems. The production system model, rules and expert system architecture. Use of a symbolic programming language. Emphasis on artificial intelligence applications in industrial and manufacturing planning and scheduling. Nonmajor graduate credit.

IE 466. Multidisciplinary Engineering Design. (Same as A E 466, Cpr E 466, E E 466, E Sci 466, M E 466, Mat E 466.) (1-4) Cr. 3. F.S. *Prereq:* *Student must be within two semesters of graduation and receive permission of the instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, and project scheduling, cost estimating, quality control, manufacturing process. Development of a prototype and appropriate documentation in the form of written reports, oral presentations and computer models and engineering drawings.

IE 471. Safety and Reliability in the Design of Work Systems. (3-3) Cr. 3. Alt. S., offered 2000. *Prereq:* 271. The quantitative study of work systems through the methods of engineering analysis and design, human reliability analysis, and the use of simulation to model workplace hazards. Nonmajor graduate credit.

IE 476. Designing for the Worker in Industrial Systems. (2-2) Cr. 3. Alt. F., offered 2000. *Prereq:* 271. Physical, psychological, and environmental factors affecting human performance in the workplace. Emphasis on the solving of, and designing to eliminate or reduce industrial ergonomic problems. Nonmajor graduate credit.

IE 490. Independent Study. Cr. 1 to 5 each time elected. *Prereq:* *Senior classification, permission of instructor.* Independent study and work in the areas of industrial engineering design, practice, or research.

- H. Honors
- J. Applied Operations Research
- K. Manufacturing
- L. Ergonomics

IE 498. Cooperative Education. Cr. R. F.S.S.S. *Prereq:* *Permission of department chair; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

(An undergraduate student must have an academic standing in the upper one-half of his/her class to enroll in any 500-level industrial engineering course.)

IE 502. Capital Expenditure Programming. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 305 or 304. Computerized economic decision package. Critique of rate of return and present worth figures of merit. Recognition of mixed investments. Multiple root solving algorithm. Ranking inconsistency problem. Mortgage equity analysis.

IE 508. Design and Analysis of Allocation Mechanisms. (3-0) Cr. 3. S. *Prereq:* 312 or Math 307. Market-based allocation mechanisms from quantitative economic systems perspective. Pricing and costing models designed and analyzed with respect to decentralized decision processes, information requirements, and coordination. Case studies and examples from industries such as regulated utilities and semiconductor manufacturers.

IE 510. Network Analysis. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 312, 313. Deterministic network flows, generalized analysis of capacitated deterministic networks, stochastic networks, and network optimization. Methods and applications of

network analysis to various engineering and optimization problems.

IE 512. Introduction to Stochastic Production Systems. (3-0) Cr. 3. S. *Prereq:* 313. Study modeling techniques to evaluate performance, and address issues in design, control and operation of systems; Markov models of single-stage make-to-order systems with single and multiple servers, with extensions to multi-product case; approximations for general systems based on sample path analysis.

IE 514. Production Scheduling. (Same as Stat 514.) (3-0) Cr. 3. S. *Prereq:* 312, 341. Introduction to the theory of machine shop systems. Complexity results for various systems such as job, flow and open shops. Applications of linear programming, integer programming, network analysis. Enumerative methods for machine sequencing. Introduction to stochastic scheduling.

IE 519. Simulation Modeling and Analysis. (3-0) Cr. 3. F. *Prereq:* *Com S 311, Stat 401.* Event scheduling, process interaction, and continuous modeling techniques. Probability and statistics related to simulation parameters including run length, inference, design of experiments, variance reduction, and stopping rules. Aspects of simulation language.

IE 520. Knowledge Based Manufacturing Systems. (2-3) Cr. 3. S. *Prereq:* 419 or 465 or Com S 472. Knowledge-based systems as applied to automated manufacturing, production planning and scheduling, group technology, robotics, facilities design, and process control. Knowledge representation, search, and predicate calculus.

IE 521. Biomechanics. (Same as BME 521, E M 521.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* *Phys 111 or 221, Math 265.* For students with interests in the life sciences, ergonomics, or rehabilitation engineering. Topics include equilibrium, motion, energy, stress and deformation, material properties, flow of fluids, dimensional analysis and modeling of biological systems. Illustrative examples taken from biology and medicine.

IE 531. Statistics for Quality and Productivity. (Same as Stat 531.) See *Statistics*.

IE 533. Reliability. (Same as Stat 533.) See *Statistics*.

IE 534. Linear Programming. (3-0) Cr. 3. F. *Prereq:* 312. Develop linear models. Theory and computational aspects of the simplex method. Duality theory and sensitivity analysis. Introduction to interior point methods and column generation. Multiobjective linear programs.

IE 539. Game Theory. (Same as Stat 539.) See *Statistics*.

IE 541. Inventory Control and Production Planning. (3-0) Cr. 3. F. *Prereq:* 341. Economic Order Quantity, dynamic lot sizing, newsboy, base stock, and (Q,r) models. Material Requirements Planning, JIT, variability in production systems, push and pull production systems, aggregate and workforce planning, and capacity management.

IE 542. Computer-Aided Manufacturing I. (3-0) Cr. 3. F. *Prereq:* 374. Applications of computer technologies in planning and controlling manufacturing processes. Computer numerical controls, CNC programming languages, flexible automation, communication protocols, process planning. CAD/CAM integration and software aspects of computer-integrated manufacturing.

IE 543. Material Handling. (3-0) Cr. 3. F. *Prereq:* 312, 443. Design and analysis of material handling systems with emphasis on modeling, material flow control, integration, automation, storage and warehousing. Relationship and concurrent consideration of material handling and facilities location and layout, product and process design, and scheduling.

IE 544. Geometric Modeling in CAD/CAM. (3-0) Cr. 3. Alt. S. offered 2000. *Prereq:* *Math 267, knowledge of C language.* Representation and manipulation of curves, surfaces, and solids for applications in the context of intelligent manufacturing systems, such as process planning, assembly planning, tolerance analysis and allocation, inspection in quality

control, group technology, and manufacturing cost minimization.

I E 565. Systems Engineering and Analysis. (Same as Aer E 565, E E 565.) (3-0) Cr. 3. F. *Prereq:* Graduate classification in engineering. Introduction to organized multidisciplinary approach to designing and developing systems. Concepts, principles, and practice of systems engineering as applied to large integrated avionics systems. Life-cycle costing, scheduling, risk management, functional analysis, conceptual and detail design, test and evaluation, and production. Not available for degrees in industrial engineering.

I E 566. Applied Systems Engineering. (3-0) Cr. 3. S. *Prereq:* E E/Aer E/I E 565. Engineering procedures for profit planning, capital investment, program and cost control, and process planning. Modeling, optimization, utility theory, decision analysis, game theory, and experimental design. Systems engineering organizing architectures of product, process, and management. Students will be required to apply the principles of systems engineering to a project including proposal, program plan, systems engineering management plan, and test and evaluation plan. Not available for degrees in industrial engineering.

I E 575. Advanced Ergonomic Analysis. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* Phys 221, Stat 231. Ergonomic data analysis using statistical, graphical, computational intelligence, and virtual reality methods for problem diagnosis and process/product design. Data collection and interpretation techniques for anthropometry, biomechanics, work physiology, information processing, and human computer interaction. Illustrations drawn from work design, rehabilitation, and human-computer interaction.

I E 577. Human Factors. (2-2) Cr. 3. Alt. F., offered 1999. *Prereq:* 271, Stat 231 or 401. Physical and psychological factors affecting human performance on systems. Signal detection theory, human reliability modeling, information theory, and performance shaping applied to safety, reliability, productivity, stress reduction, training. Laboratory assignments related to system design and operation.

I E 590. Special Topics. Cr. 1 to 5 each time elected. Independent study and work to explore recent advances and innovative approaches to industrial engineering design, practice, and research.

J. Applied Operations Research
K. Manufacturing
M. Ergonomics

I E 599. Creative Component. Cr. var.
A. Major in Industrial Engineering
C. Major in Operations Research

Courses for Graduate Students

I E 631. Nonlinear Programming. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 534. Develop nonlinear models, convex sets and functions, optimality conditions, Lagrangian duality, unconstrained minimization techniques. Constrained minimization techniques covering penalty and barrier functions, sequential quadratic programming, the reduced gradient method.

I E 632. Integer Programming. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 534. Integer programming including cutting planes, branch and bound, and search enumeration. Goal programming and specialized algorithms.

I E 642. Simultaneous Engineering in Manufacturing Systems. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 441 or M E 415. Current engineering methods for the product life cycle process. Feature-based design, computer-aided process planning, and data-driven product engineering.

I E 645. Computer-Aided Manufacturing II. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 542, 544. Advanced research projects in computer aided manufacturing. Geometric tolerancing, CNC hardware and software issues, process planning and control, integrated manufacturing systems.

I E 690. Advanced Topics. Cr. var.

I E 699. Research. Cr. var.
A. Industrial Engineering
C. Operations Research

Industrial Relations

(Interdepartmental Graduate Program)

Supervisory Committee: Paula C. Morrow, Chair; C.D. Anderson, K. A. Hanisch, Y. S. Lee, J. P. Mattila, J. C. McElroy

Work is offered for the degree master of science with a major in industrial relations. This is a multidisciplinary degree offered cooperatively by the departments of Economics, Management, Political Science, Psychology, and Sociology.

Graduates understand and know how to manage human resources in business and non-profit organizations. They possess the analytical and interpersonal skills necessary to function as human resource professionals. They understand various aspects of the employment relationship and the techniques for improving the quality of work life in an increasingly diverse, global, and technologically oriented labor force. Graduates demonstrate strong oral and written communication skills as well as the ability to lead groups and teams.

Students who enroll in industrial relations usually receive their undergraduate background in economics, business administration, political science, psychology, or sociology. Admission is not restricted to students from these majors, however. Students entering industrial relations ideally should have a broad background in the social sciences.

The program in industrial relations is regarded as education for both professional practice and scientific inquiry. Through the Industrial Relations Center and its interdisciplinary faculty, facilities and opportunities exist for research of both a fundamental and applied nature on a variety of problems concerned with the world of people at work.

A student majoring in industrial relations will choose a major professor from the graduate faculty of the cooperating departments. The student's program of study will be developed with the guidance of an advisory committee selected by the student and the major professor, and approved by the chair of the Industrial Relations Supervisory Committee. Students may elect the thesis option (consisting of 30 semester-hour credits) or the nonthesis option (consisting of 36 semester-hour credits).

Regardless of which option is taken, all students must take the following core courses: Econ 320, Econ 322, Mgmt 570, Mgmt 571, and Stat 401. For students enrolled in the nonthesis option, the research component of their degree program will be satisfied via the completion of a 3-credit creative component. For students enrolled in the thesis option, the research component of their degree program will be satisfied via the completion of a 6-credit thesis. The balance of the program of study for students in either option will consist of electives from the recommended courses in the industrial relations curriculum, with a maximum of four courses in any one department. A minimum of 12 semester credits must be taken from 500-level (or above) courses. In general, the degree program in industrial rela-

tions is designed to be as flexible as possible to support the student's own professional interest. Satisfactory completion of a final comprehensive oral examination is required of all students. As part of their graduate education, students enrolled in the nonthesis program have the option of enrolling in an off-campus internship program.

Courses appropriate for the master of science degree are determined by the student's program of study committee. Sample recommended courses for graduate students majoring in industrial relations include: Econ 320, 322, 590; Fin 555; I Tec 504, 506; Mgmt 501, 507, 511, 512, 570, 571, 573, 575, 590; MIS 503; Pol S 547, 571, 572, 573, 574, 575, 576, 590; Psych 440, 450, 550, 590, 623; Soc 420, 511, 528, 529, 530, 532, 590B, 642; Stat 401, 402. See departmental listings for course descriptions and credits.

Courses for Graduate Students

I R 598. Internship. Cr. 1 to 6 each time taken, maximum of 6. *Prereq:* Graduate enrollment in industrial relations. Internship designed for work exposure in a human resources or labor relations department of a private or public employer. Not recommended for students already having had such work experience. Offered on a satisfactory-fail grading basis only.

I R 599. Creative Component. Cr. 3. Preparation and writing of creative component. Offered on a satisfactory-fail grading basis only.

I R 699. Research. Cr. 1 to 6 each time taken, maximum of 6. Offered on a satisfactory-fail grading basis only.

Industrial Technology

(Administered by the Department of Industrial Education and Technology)

Daniel L. Householder, Chair of Department

Professors: Dyrenfurth, Householder, Smith

Professors (Emeritus): Howe, Miller, Parks, Riley, Wiener

Associate Professors: Dugger

Associate Professors (Collaborators): Gelina

Associate Professors (Emeritus): Weber

Assistant Professors: Bradshaw, Chang, Chen, Field, Freeman

Assistant Professors (Adjunct): Drake

Instructors (Adjunct): Wolff

Undergraduate Study

For the undergraduate curriculum in industrial technology leading to the degree bachelor of science, see *College of Education, Curricula*.

The industrial technology curriculum provides preparation for employment in industry or business, in manufacturing (quality, production supervision, process planning, tooling, etc.), occupational safety (safety engineer, loss control specialist, safety director, etc.), or training and development (technical trainer, training coordinator, instructor, etc.).

Graduates understand the properties of basic manufacturing materials, the commonly used manufacturing processes, the legislative and

regulatory issues affecting manufacturing, and issues related to technical training in manufacturing. They are skilled in establishing and utilizing groups for problem solving activities. In addition, they are skilled in selecting value added activities from processes that include both value and non-value added steps.

Graduate Study

The department offers work for the master of science and doctor of philosophy degrees with a major in industrial education and technology, and minor work for students taking major work in other departments. Within the industrial education and technology major, a student may emphasize technology education, industrial technology, technical education, training and development or safety.

Prerequisite to major graduate work is preparation equivalent to the completion of the undergraduate curriculum in industrial technology at Iowa State University and adequate proof that the student ranks above average in scholastic ability.

Graduates have a broad understanding of industrial technologies and are able to communicate effectively with colleagues, industry leaders, career and technology educators, and the general public in both formal and informal settings. They are prepared to carry out research, communicate research results, prepare grant proposals and address complex problems facing manufacturing, safety and health, and training professionals in industry and education. Graduates are committed to life-long learning and the pursuit of excellence in their chosen field.

The department stipulates no foreign language requirement for either the master of science or doctor of philosophy degree.

Students not electing the thesis option at the master's degree level will be required to complete a minimum of 3 credits of a creative component project.

Industrial Technology (I TEC)

Courses Primarily for Undergraduate Students

I Tec 110. Introduction to Industrial Technology. (1-0) Cr. R. F.S. Qualifications, opportunities, preparation, and duties of personnel in the field of industrial technology. Specific information about the three options: manufacturing technology, training and development, and occupational safety. Philosophy, structure, and goals of the university and department. Required for all undergraduate students within the Industrial Technology major. Offered on a satisfactory-fail grading basis only.

I Tec 120. Introduction to Technical Graphics, Interpretation and CAD. (2-4) Cr. 4. F.S. Basic systems for representing size and shape descriptions for manufacturing applications. Topics include: sketching, scales, AutoCAD, orthographic projection, pictorials, dimensions and tolerances, auxiliaries, sections, and drawing interpretation. Materials fee.

I Tec 130. Introduction to Non-metallic Manufacturing Materials, and Processes. (1-4) Cr. 3. F.S. An introduction to selected non-metallic materials used in manufacturing and the related processes. Laboratory and lecture activities focus on the understanding of thermal, chemical, electrical, and mechanical properties of non-metallic materials. Materials fee.

I Tec 140. Electrical Fundamentals. (1-4) Cr. 3. F.S. *Prereq: Physics 111 and Math 160.* Electrical phenomena theory will include but not be limited to Ohm's, Kirchoff's, and Power Laws. Thevenin and Superposition Theorems will be presented. Students will become familiar with concepts of frequency, various wave forms and various loads. Concepts of phase angle, transient timing, and step up/step down of voltages and current will be introduced. Materials fee.

I Tec 141. Electrical Fundamentals for Industrial Safety Personnel. (1-4) Cr. 3. F. *Prereq: Phys 111.* The safe practice of electricity in their environments. Concepts of Voltage, current, power and their distribution to various loads will be studied. Testing procedures for electrical safeness and circuits will be explored. Electrical code will be examined and practical work to assist in understanding GFI and grounding will be carried out. Safe practice and choice of component specification will be presented as well as safety issues in the manufacture of electrical components. Materials fee.

I Tec 202. Introduction to Training and Development in Industry and Business. (3-0) Cr. 3. F.S. A systemic overview of the training and development function and how it is essential to today's organization. Needs assessment, learning objectives, learning theories, training program development, delivery, transfer and evaluation are explored. Materials fee.

I Tec 216. Computer Applications in Industrial Technology. (2-2) Cr. 3. Provides a working knowledge of microcomputers and their application in industrial technology. Emphasis on C programming language. Materials fee.

I Tec 224. Advanced Technical Graphics, Interpretation, and CAD. (2-4) Cr. 4. F.S. *Prereq: 120.* Advanced design systems incorporating 2D and 3D design and productivity tools for use in manufacturing settings. Topics include: Geometric Tolerancing, 3D models, planar and coordinate systems, solid modeling, feature based design, assemblies, ProEngineer software. Materials fee.

I Tec 231. Introduction to Metallic Materials and Processes. (1-6) Cr. 3. F.S. *Prereq: 130.* A study of selected metallic materials used in manufacturing and the related processes. Lecture and laboratory activities focus on properties of metallic materials and processes parameters. Materials fee.

I Tec 240. Analog Manufacturing Applications. (1-4) Cr. 3. F.S. *Prereq: 140.* Amplification fundamentals for voltage, current, and power. Amplification techniques by means of Bipolar junction, Field effect transistors, Operational amplifiers, and Darlington configurations applied to impedance matching of sensors and relays and for motor control. Split Power supplies will be introduced for developing op am circuitry. Materials fee.

I Tec 244. Integrated/Mechanical Fluid Systems. (1-4) Cr. 3. F.S. *Prereq: 140.* Modern mechanical/fluid power systems. Includes laws of mechanics, components, circuits, and instrumentation. Emphasis on control and utilization. Materials fee.

I Tec 270. Principles of Accident Prevention. (3-0) Cr. 3. F.S. Basic foundations of accident causation and prevention in home, motor vehicle, public, and work environments. Materials fee.

I Tec 272. Introduction to Occupational Safety. (3-0) Cr. 3. F.S. *Prereq: 270.* Introduction to industrial accident prevention as it relates to safety and health, administration and management of safety and health programs. Materials fee.

I Tec 290. Construction Safety. (2-0) Cr. 2. F.S. *Prereq: 270.* Identifies the hazards of life and property, particularly to the workers in the construction industry. Includes the use of equipment, fall protection, excavation, for both construction and demolition. Materials fee.

I Tec 293. Hazardous Materials Handling. (3-0) Cr. 3. F.S. *Prereq: 272, Chem 163, Chem 163L.* Characteristics and risks associated with hazardous materials; legislation related to hazardous materials; control measures applicable to bulk handling, storage, and transportation of hazardous materials; plan-

ning for emergencies associated with hazardous materials. Materials fee.

I Tec 294. Legal Aspects of Occupational Safety and Health. (3-0) Cr. 3. F.S. *Prereq: 272.* Legal implications of legislation as it applies to health and safety in the workplace. Materials fee.

I Tec 296. Fire Protection and Prevention. (3-0) Cr. 3. F.S. *Prereq: 272.* An overview of the current problems and technology in the fields of fire protection and fire prevention, with emphasis on industrial needs, focusing on the individual with industrial safety responsibilities. Materials fee.

I Tec 297. Accident Investigation and Response. (3-0) Cr. 3. F.S. *Prereq: 272.* Focuses on various aspects of accident investigation, reporting, and corrective action. Worker compensation process is emphasized. Materials fee.

I Tec 303. Industrial Training Needs Assessment. (3-0) Cr. 3. F.S. *Prereq: 202.* Examines the importance of assessing an organization's performance improvement needs and a systems approach to addressing learning problems. Models, processes and methods of performance diagnosis; approaches to linking identified needs to appropriate HRD solutions; and justification are examined. Materials fee.

I Tec 330. Polymer and Composite Processing. (1-4) Cr. 3. F.S. *Prereq: 130.* Design and production considerations of separating, joining, forming, and conditioning of plastics. A study of plastic properties and their relationship to processing parameters and control techniques. Materials fee.

I Tec 336. Automated Manufacturing Processes. (2-2) Cr. 3. F.S. *Prereq: 224, 231.* NC programming operations for CNC mills and lathes. The transfer of parts descriptions into detailed process plans, tool selection, and NC machine codes. Computer-assisted CAD/CAM NC programming for 2D machining is emphasized. Verification is accomplished through laboratory work. Materials fee.

I Tec 340. Digital Manufacturing Applications. (1-2) Cr. 2. F.S. *Prereq: 240.* Logic gates, truth tables and applications for hardwired industrial controls, digitally controlled stepper motors, PLC programming, ladder logic, A/D, D/A conversion, decoding and multiplexing. Materials fee.

I Tec 360. Total Quality Improvement. (3-0) Cr. 3. F.S. *Prereq: Stat 101, junior classification.* Application of the Deming methodology to establish a defect prevention system for any type of work activity. Focus on customer; participative management through teamwork; emphasis on continuous improvement; application of SPC methods using the Gelina problem-solving model. Materials fee.

I Tec 392. Safety in Manufacturing. (3-0) Cr. 3. F.S. *Prereq: 270.* Identifies safety and health risks in industrial work environments, particularly to workers in manufacturing industries. Includes the prevention of workplace exposures, and the safe use of equipment for materials handling and production operations. Materials fee.

I Tec 395. Seminar in Industrial Technology. (1-0) Cr. 1. *Prereq: Junior classification.* An exploration of employment opportunities, requirements, benefits, and procedures involved in seeking internships and employment. Materials fee.

I Tec 402. Facilitation of Workplace Learning. (3-0) Cr. 3. S. *Prereq: 303.* Application of theories of learning and motivation; effective participative learning facilitation and delivery techniques; analysis and maximization of learning styles; learner goal-setting and feedback; and the incorporation of learning to learn skills are explored for the purpose of preparing workplace learning facilitators. Materials fee.

I Tec 405. HRD Program and Workplace Learner Evaluation. (3-0) Cr. 3. F. *Prereq: 402.* Examining and developing techniques for evaluating HRD program effectiveness and individual learning. Provides skill development in evaluating skill and knowledge improvements, job performance improvements, and impacts in organizational outcomes resulting from workplace learning. Various methods of evaluation are analyzed. Materials fee.

I Tec 406. Topics in Workplace Learning. (3-0) Cr. 3. S. *Prereq:* 202. Current issues in workplace learning research and application are explored. Materials fee.

I Tec 408. Interdisciplinary Problem Solving. (Same as BusAd 408, I E 408, E E 408.) (3-0) Cr. 3. F.S. *Prereq:* Junior or senior standing. Practice effective problem solving, communication and engineering/business interfacing skills. Teams develop and exercise techniques needed in win-win negotiation, conflict resolution, improving outcomes in design, project planning and effective delegation. Includes team projects, class presentation and communication simulations.

I Tec 409. Interdisciplinary Systems Effectiveness. (Same as BusAd 409, I E 409, E E 409.) (3-0) Cr. 3. F.S. *Prereq:* Junior or senior standing. Focus on functions that determine the effectiveness of an entire organization. Generic solutions to production, distribution, project management are compared to traditional solutions. Strategy for improvements discovered using simulations and group projects.

I Tec 410. Facility Planning. (3-0) Cr. 3. F.S. Principles and practices in designing, evaluating, and organizing existing facilities or creating new facilities. Includes flow analysis, layout development, material handling, and office design. Field trip. Materials fee.

I Tec 423. Statics and Strength of Materials for Industrial Technology. (1-4) Cr. 3. F.S. *Prereq:* 224, Phys 111. Application of graphic and analytic techniques of solving problems related to force. The properties of materials and how to use them. Materials fee.

I Tec 433. Materials Testing and Processing. (2-2) Cr. 3. F.S. *Prereq:* 231. Materials testing and analysis relating to manufacturing processes. Materials tested include woods, plastics, metals, ceramics, and composites. ASTM standards followed. Materials fee.

I Tec 435. Computer Automated Manufacturing Systems. (2-2) Cr. 3. F.S. *Prereq:* 336, 340. Reviews principles and concepts required for implementation of automated production techniques and for design of manufacturing systems. Includes sensors and sensing systems, numerical control, robotics, CAD/CAM, simulation, manufacturing economics. Emphasis on computer technology as "tools" to improve production and control needs. Materials fee.

I Tec 440. Electrical Outputs for Manufacturing. (1-2) Cr. 2. F.S. *Prereq:* 340. How manufacturing machines are controlled by program, sensors, logic and switches, distribution of power, A.C. and D.C. motors, electrical/mechanical relays, and solid state relays. Materials fee.

I Tec 446. Automation Systems. (2-2) Cr. 3. F.S. *Prereq:* 340. Controls and applications of industrial robotics and automated systems technology. Emphasizes features, capabilities, programming and evaluation of flexible automated systems. Materials fee.

I Tec 470. Industrial Hygiene: Chemical and Biological Hazards. (3-0) Cr. 3. F.S. *Prereq:* 272, Chem 231, 231L. A consideration of health related problems found in the industrial setting with emphasis on toxic chemicals, ventilation, and noise. Materials fee.

I Tec 471. Industrial Hygiene: Physical Hazards. (1-4) Cr. 3. F.S. *Prereq:* 272, Chem 231, 231L. The use and calibration of instruments designed to measure the quality and quantity of contaminants in the work environment. Materials fee.

I Tec 472. Systems Safety Analysis. (2-0) Cr. 2. F.S. *Prereq:* 272, Math 142, Stat 101. A study of systems safety as a management technique utilizing quantitative and qualitative methods of analysis to control risk. Topics include a variety of analytical techniques which are applied to practical system analysis problems. Materials fee.

I Tec 475. Safety Research and Design. (1-2) Cr. 2. S. *Prereq:* Completion of all safety courses or instructor approval. Students review research used in the profession. Individual or small group research/design

projects are completed in conjunction with faculty or a business/industry partner. Materials fee.

I Tec 480A. Supervised Industrial Cooperative Experience. Cr. 2 each time taken. F.S.SS. *Prereq:* Permission of cooperative coordinator. Supervised learning activity consisting of 2 or more work periods in industry. Materials fee. Offered on a satisfactory-fail grading basis only.

I Tec 480B. Supervised Industrial Cooperative Experience. Cr. R. F.S.SS. *Prereq:* Permission of cooperative coordinator. Supervised learning activity consisting of 2 or more work periods in industry. Materials fee. Offered on a satisfactory-fail grading basis only.

I Tec 481A. Supervised Industrial Internship Experience. Cr. 1 to 2 each time taken. F.S.SS. *Prereq:* Permission of internship coordinator. Supervised learning activity consisting of one work period in industry. Materials fee. Offered on a satisfactory-fail grading basis only.

I Tec 481B. Supervised Industrial Internship Experience. Cr. R. F.S.SS. *Prereq:* Permission of internship coordinator. Supervised learning activity consisting of one work period in industry. Materials fee. Offered on a satisfactory-fail grading basis only.

I Tec 490. Independent Study in Industrial Technology. 1 to 5 credits. *Prereq:* Senior classification, quality-point average of 2.5 or more for two preceding semesters and 20 credits in industrial technology. Materials fee.

- H. Honors
- M. Manufacturing
- O. Occupational Safety
- T. Training and Development

I Tec 493. Workshop in Industrial Technology. Cr. 1 to 4 each time taken. F.S.SS. *Prereq:* 15 credits in industrial technology. Extension of technical competence in emerging technologies. Materials fee.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Prior to registration for graduate-level courses, the student shall be classified as a senior or have an earned bachelor's degree, and be required to complete additional assigned readings, term papers, and graduate projects.

I Tec 502. Educational Factory - From Design to Manufacturing. (2-2) Cr. 3. *Prereq:* Permission of instructor. The study and exercises of learning how a factory working from customer's demand, design (CAD), analysis (CAE), evaluation of the cost, and planning for manufacturing (CAPP/CAM), then implementing critical control function via computer technologies in a cellular manufacturing environment. Topics include: enterprise practice in manufacturing settings; product design methods-design for manufacturing, quality, cost, assembly, safety, and reliability; manufacturing economics in product development; 3D computer aided process planning and manufacturing (CAPP/CAM) integration. Materials fee.

I Tec 504. Principles of Training and Development. (3-0) Cr. 3. F. *Prereq:* Graduate classification. An examination of the training and development function in industry and business and the advancement of competencies in analysis, design, development, implementation, and evaluation of training in conjunction with analysis and synthesis of theoretical perspectives. Materials fee.

I Tec 506. Facilitating Change Through Training and Development. (3-0) Cr. 3. S. *Prereq:* Graduate classification. Change and the change process, diagnosing and defining planned change, investigating various transformation theories and methodologies, and team development. Opportunities to apply knowledge in experiential learning environment. Materials fee.

I Tec 509. Interdisciplinary Systems Thinking. (Same as BusAd 509, E E 509.) (3-0) Cr. 3. F.S. *Prereq:* Junior or senior standing. Student does an extensive individual project using the systematic thought processes of Theory of Constraints to solve and implement the solution to a problem in their cur-

rent reality. Groups scrutinize and improve each other's work.

I Tec 510. Teaching and Learning Methods in Industrial Technology. (2-0) Cr. 2. *Prereq:* Permission of instructor. Teaching and learning implications and strategies. Focuses on trends, instructional planning, execution, collaborative-team based learning, learning to learn, and integrating workplace attitudes. Materials fee.

I Tec 514. Foundations of Industrial Technology. (2-0) Cr. 2. F. *Prereq:* Graduate classification. Historical development and philosophy. Materials fee.

I Tec 519. Curriculum Development in Industrial Technology and Training. (2-0) Cr. 2. *Prereq:* 510. Course of study development based on occupational analysis. Compilation, arrangement, and limitations of instructional materials. Materials fee.

I Tec 522. Evaluation and Outcomes Assessment in Industrial Technology. (2-0) Cr. 2. *Prereq:* 510. Theory and application of evaluation methods unique to program and learning outcomes. Materials fee.

I Tec 535. Comprehensive Modern Manufacturing Systems. (2-2) Cr. 3. SS. The study, design, and implementation of PULL manufacturing systems and their integration with functions of the production system for the manufacture of superior quality, low cost products. Topics include cellular manufacturing system, group technology, cost estimation/justification, dynamic cost control, JIT manufacturing, integrated quality, inventory control, automation, and CAD/CAM. Materials fee.

I Tec 549. Internship in Industrial Technology. (arr.) Cr. 1 to 4 each time taken. F.S. *Prereq:* 10 hours in industrial technology. Emphasis on full experience in Industrial Technology, Training and Development, and Technical Education as it relates to administration-supervision, special needs, curriculum-instruction, and evaluation-research. Materials fee.

I Tec 554. History and Philosophy of Industrial Technology. (3-0) Cr. 3. An evaluation of educational and industrial thought. Historical and philosophical development of Industrial Technology, Training and Development, and Technical Education to the present; trends and implications. Materials fee.

I Tec 555. Administration and Supervision of Industrial Technology. (3-0) Cr. 3. Administration, supervision, curriculum development, selection of staff, and public relations. Evaluating administrative and supervisory efforts; program modification. Materials fee.

I Tec 561. Applied Techniques in Energy and Power. (1-2) Cr. 2. *Prereq:* 244, 440. Development of integrated energy systems. Implementation of computers to control and collect data for statistical based decisions about process control. Materials fee.

I Tec 580. Applied Techniques in AutoCAD. (2-2) Cr. 3. *Prereq:* Graduate classification. Exploration of computer graphics, design and drawing applications using AutoCAD. Complete two-dimensional concepts of data entry, editing, screen display, layering, libraries, dimensions, and plotting. Three-dimensional coordinate systems, 3D entity creation, editing, and solid modeling will be introduced. Materials fee.

I Tec 582. Microcomputers in Industrial Technology. (1-4) Cr. 3. *Prereq:* 15 credits in industrial education and technology. The use of microcomputers in industrial technology, C language emphasized. Materials fee.

I Tec 590. Special Topics in Industrial Education and Technology. Cr. 1 to 4. *Prereq:* Graduate classification in industrial technology.

- M. Manufacturing
- O. Occupational Safety
- T. Training and Development

I Tec 593. Workshop in Industrial Technology. Cr. 1 to 3 each time taken. F.S.SS. *Prereq:* Graduate classification. Materials fee.

I Tec 599. Creative Component. Cr. 1 to 3. F.S.SS. A discipline-related problem to be identified and completed under the direction of the program adviser.

Three credits required for all nonthesis master's degree students.

Courses for Graduate Students

I Tec 615. Seminar. Cr. 1 each time taken. F.S. Process of selecting, developing and writing a research proposal. Forum for dealing with professional and academic needs and issues. Materials fee.

I Tec 652. Program and Learner Evaluation. (Same as ResEv 652.) (3-0) Cr. 3. *Prereq: Stat 401 or equivalent.* Techniques for evaluating learners, facilities, programs, and staff utilizing theories for developing measurement instruments. Outcomes assessment and ROI is emphasized. Materials fee.

I Tec 657. Curriculum Development in Industrial Technology. (3-0) Cr. 3. *Prereq: 15 credits in industrial technology.* Basic concepts, trends, practices, and factors influencing curriculum development, techniques, organization and procedures. Emphasis will be given to program/course of study and training plan development. Materials fee.

I Tec 699. Research. Cr. arr.

Interdisciplinary Studies

A major in interdisciplinary studies is offered in the College of Liberal Arts and Sciences for undergraduate students who have unique interdisciplinary educational goals. The major is designed by a faculty review board, the academic adviser, and student. Leading to either the bachelor of arts or the bachelor of science degree, the major includes 36 to 48 credits of coursework chosen to provide a coherent, carefully planned program in an area of interest that bridges two or more departments. This specialized area is identified on the diploma.

A student seeking admission to the program in interdisciplinary studies writes a letter of application that explains how the proposed major meets specific educational goals. Applications are screened by a faculty review board. Since students are expected to earn at least 30 credits after they are admitted into the program, the proposal is ordinarily submitted to the review board in the sophomore or junior year. The proposal will be considered if the area of interest properly falls within the College of Liberal Arts and Sciences and if the student's educational goals cannot be accommodated by a more traditional combination of existing majors, minors, and electives. Areas of interest in Interdisciplinary Studies have included Classical Studies, International Relations, Ecology Studies, African American Cultural Studies, Asian Studies, and U.S. Latino/a Studies.

Students who wish to prepare for professional schools in health-related fields and students who wish to develop an area of interest based upon one of the College's cross-disciplinary programs may wish to propose a degree in Interdisciplinary Studies.

The interdisciplinary studies major must satisfy the requirements of the liberal arts and sciences curriculum in the College of Liberal Arts and Sciences. With the approval of the review board, the student will identify courses leading to either the B.A. or the B.S. degree. (A major emphasizing the humanities or communicative arts normally leads to a B.A.; a major emphasizing the natural or social sciences normally

leads to a B.S.) Different requirements for the B.A. and B.S. degrees are determined by the nature of the chosen field of study.

Courses listed in the major may come from any department of the university with the following restrictions:

1. The selection of courses needs to focus on a single theme and be consistent with the career and educational goals of the student.
2. At least one half of the courses must come from degree-offering departments within the College of Liberal Arts and Sciences.
3. The courses must be chosen from at least two disciplines.
4. The courses chosen for the major must be at the 200 level or higher. Overall, the degree program must include 45 credits at the 300 level or higher, with at least 6 credits at the 400 level or higher.
5. An average grade of C or better must be earned in 15 credits at the 300 level or higher in the major in courses taken at Iowa State University.
6. The university diversity and international perspectives requirement may be met by choosing two 3-credit courses from the approved list.

The following English proficiency requirements applies:

1. An average grade of C or better is to be earned in Engl 104 and 105. If this grade is not achieved, the student will be required to take an additional writing course and earn a grade of C or higher.
2. A grade of C or better must be earned in either an advanced English composition course or a course in the major with a significant writing component.

Further information may be obtained from the college office.

Interdisciplinary Graduate Studies

(Interdepartmental Graduate Program)

Supervisory Committee: P. M. Keith, Chair; J. S. Ruebel (Arts and Humanities), E. C. Powell (Biological and Physical Sciences), P. M. Keith (General), E. C. Jones (International Development Studies), S. J. Crase, (Social Sciences)

The degree of master of science or master of arts with major in interdisciplinary graduate studies is available to graduate students who wish to have a more diversified program of advanced study than that generally permitted students who specialize in a single subject. Areas of specialization in arts and humanities, biological and physical sciences, international development studies, physical sciences, social sciences, and a general area are designed to broaden and supplement a student's program. Students must take courses in three different graduate subject matter areas, each subject contributing a minimum of nine credits toward the 35 graduate credits required for the degree. Courses which may be used for credit

toward this degree program are selected from those listed in the Graduate College Catalog for graduate credit.

Both thesis and nonthesis options are available except in arts and humanities in which a thesis is required. If the thesis option is chosen, a minimum of three credits of IGS 699 (Research) is required and a maximum of five credits of IGS 699 may be counted in the total of 35 required credits. If the nonthesis option is elected, evidence of original creative effort must be presented. This may be in the form of a demonstration of independent creativity such as a written report of laboratory, field, or library research; a project in fine arts; or some other original contribution acceptable to the student's committee. In the nonthesis option a minimum of three credits of IGS 599 (Creative Component) is required and a maximum of five credits of IGS 599 may be counted toward the total of 35 graduate credits. The student, in consultation with the program of study committee, will decide on the option. The committee also aids the student in planning a program of study and in selecting appropriate courses.

Foreign language requirements, if any, will be decided by the student's committee.

Graduates will have experience in designing their own program centered around issues they have identified. Because of the interdisciplinary nature of IGS, students are expected to synthesize knowledge from three different areas of study.

Students who wish to apply for admission to interdisciplinary graduate studies should communicate with the chair of the program, the chair of the supervisory committee or one of its members (see above).

Courses for Graduate Students

IGS 599. Creative Component. Cr. var.

IGS 699. Thesis Research. Cr. var.

International Agriculture

(Interdepartmental Undergraduate Program)

Supervisory Committee: Robert A. Martin, Chair; Ricardo Salvador; Elwood Hart; Anthony Pometto III; Robert Andrews

The international agriculture program provides opportunities to develop knowledge and skills related to the factors that interact to impact agricultural and environmental issues, production, processes, distribution and utilization worldwide. The program puts emphasis on international experience through structured internships and study abroad. The international agriculture program is appropriate for students seeking positions that require knowledge and experience related to global agricultural issues and their impact on local, regional, national and international policies and practices. Students preparing for careers in the following areas will benefit from the international agriculture program; governmental and non-governmental development agencies, agribusinesses, educational institutions, and non-profit

assistance agencies. Outcomes from participation in this program focus on developing an awareness for the role of international agriculture in the career development process, analyzing international agricultural issues and policies, acquiring skills for solving problems in international development and agri-business and experiencing real situations and gaining perspectives about agriculture in a global setting.

Secondary Major

International agriculture is an undergraduate secondary major that may be taken only in conjunction with a primary major in an agriculture curriculum. Students choosing international agriculture will strengthen their career placement with a business or agency involved in international activities. Technical knowledge of a primary major discipline will be strengthened by a global awareness of agriculture. A secondary major in international agriculture will give students practical insight into the role of agriculture in a world of increasing food and fiber needs. It is ideal for those who wish to broaden their international perspective or prepare for international work in agriculture. The secondary major includes an emphasis on international and/or foreign languages, and selection of appropriate courses (from an approved list) to meet the needs and interests of the student.

See *International Agriculture, Curriculum*, for the specific program. Students interested in earning a secondary major in international agriculture must contact a program adviser. The early indication of an interest in international agriculture allows for effective integration of the secondary major course requirements with those of the primary major.

Minor

A minor in international agriculture is available to interested students regardless of their major. Students selecting the minor should have at least minimal familiarity with agriculture and agricultural systems.

Courses for the minor should come from the following list: Internship; Study Abroad; Foreign Language; Agron 342; TSC 341; Pol S 241; Agron 406X; Econ 370; and Econ 385. Nine credits of the 15 credit total for the minor can not be used for meeting requirements for the major.

For more information about a secondary major or minor in international agriculture, see descriptions in the designated departments or the supervisory committee.

For more information about courses required for either a secondary major or a minor in international agriculture, see descriptions in the designated departments.

International Business

Interdepartmental Undergraduate Secondary Major

Supervisory Committee: August Ralston (chair), Mary Anderson, Virginia Blackburn, John Wong

The international business program is designed to provide students with information that will enable them to work for companies that are involved with international business. Students are expected to develop an understanding of international business issues applied to the different functional areas of business. They will also develop skills to prepare themselves for business positions with international responsibilities. The program is designed to prepare students for employment in multinational companies and for business assignments beyond the United States.

International business is an undergraduate secondary major that may be taken only in conjunction with a primary major in business. Technical knowledge of international business will strengthen the expertise acquired with the primary major. Business students pursuing this program should strengthen their placement opportunities with multinational corporations.

A student in the College of Business may earn a secondary major in International Business. The requirements for this major include 12 credits in international business courses, one year of the same university-level foreign language (minimum of 6 credits) and an approved international experience (minimum 3 months). Students who pursue this secondary major will be required to complete the requirements for a primary major in Business. Fifteen of the 18 credits required for the International Business major must not simultaneously be used to meet any other department, college or university requirement.

International Studies

(Interdepartmental Undergraduate Major and Minor)

Supervisory Committee: Steffen W. Schmidt (LAS), Chair; T. Austin (Engineering), M. Whigham (Education), W. Grundmann (Design), S. Hendrich (FCS), R. Martin (Ag), U. Platt (Vet Med), H. Van Auken (Business), two student members

The international studies program provides opportunities for students to develop skills and understanding about international events, issues, and problems. Each college has specific requirements. Students will be advised by the representative from the college of their primary major on the Supervisory Committee (see above).

International studies students are strongly encouraged to participate in a study abroad program. Planning should occur early in a stu-

dent's academic career. Options include participating in one of ISU's semester abroad programs, enrolling in a foreign university with which ISU has an exchange agreement, or participation in programs offered through other institutions. The Study Abroad Center in the Office of International Students and Scholars (OISS) located in Hamilton Hall has information on specific offerings as well as materials on financial assistance.

A secondary major and a minor in international studies are available for undergraduates. The program requirements are outlined below. The international studies program is designed for students who wish to prepare for work in the international area, such as in foreign service, journalism, advocacy organizations, scientific or research institutions, overseas business, development projects or for careers with international organizations.

Secondary Major

The international studies major may be taken only as a secondary major program (i.e., together with another major) in most colleges except Family and Consumer Sciences where it may also be a primary major.

A student seeking a secondary major in international studies must successfully complete a minimum of 24 credits in courses approved for use in the international studies program, including University Studies 235 and 430. The member of the University International Studies Committee in the college of the student's primary major degree program can provide a list of approved courses.

In addition to the 24 credits in approved courses, a student seeking a secondary major must demonstrate the equivalent of two years of university-level study in one language in addition to English. A student whose language is other than English must pass Engl 105 with a grade of C or better.

Majors participating in a study abroad program, may petition to use up to nine credits of work to meet the 24-credit requirement in international studies courses.

Minor

A student seeking a minor in international studies must successfully complete a minimum of 15 credits in courses approved for use in the international studies program, including University Studies 235 and 430. Interested students should see a representative of the University International Studies Committee in the college of their primary major or degree program for the list of approved courses.

In addition to the 15 credits in approved courses, a student seeking a minor must demonstrate the equivalent of one year of university-level study in one language in addition to English. A student whose language is other than English must pass Engl 105 with a grade of C or better.

Minors who study abroad may petition to use up to four credits of work to meet the 15-credit requirement in international studies courses.

Students interested in the minor should consult with the representative of the University International Studies Committee from the college of the student's primary major or degree program.

International Studies (IntSt)

Procedures for obtaining credit for international study programs vary by program. In some, such as exchange programs, students enroll in the foreign institution and transfer credit back to Iowa State University. In international study programs designed for specific majors, students enroll in specified Iowa State University courses within the appropriate departments. In others, students may obtain Iowa State University credit through enrollment in the international study courses listed below. Information about international study opportunities, requirements, and procedures for obtaining university credit may be obtained from academic advisers, college representatives to the University International Studies Committee, or the Study Abroad Office located in the Office of International Students and Scholars (OISS).

The Iowa Regents institutions provide a number of regularly scheduled international programs and study opportunities. These programs are sponsored by Iowa State University, the University of Iowa, and the University of Northern Iowa, and take place during the regular academic year or the summer session. They involve Iowa State faculty and students and are held in several locations. Students register for ISU credit before leaving campus.

Courses Primarily for Undergraduate Students

IntSt 120. Study Abroad Credit. (Same as U St 120.) Cr. var. *Prereq:* *Permission of the program coordinator.* ISU offers numerous opportunities for study abroad. Please contact the study abroad center or your academic advisor for current programs.

IntSt 220. Study Abroad Credit. (Same as U St 220.) Cr. var. *Prereq:* *Permission of the program coordinator.* ISU offers numerous opportunities for study abroad. Please contact the study abroad center or your academic advisor for current programs.

IntSt 235. Introduction to International Studies. (Same as U St 235.) (3-0) Cr. 3. F,SS. Overview of international studies, emphasizing cultural, geographic, economic, and political characteristics of major world areas, and nations.

IntSt 320. Study Abroad Credit. (Same as U St 320.) Cr. var. *Prereq:* *Permission of the program coordinator.* ISU offers numerous opportunities for study abroad. Please contact the study abroad center or your academic advisor for current programs.

IntSt 420. Study Abroad Credit. (Same as U St 420.) Cr. var. *Prereq:* *Permission of the program coordinator.* ISU offers numerous opportunities for study abroad. Please contact the study abroad center or your academic advisor for current programs.

IntSt 430. Seminar in International Studies. (Same as U St 430.) (3-0) Cr. 3. S. Capstone seminar in international studies focused on cultural, economic, political, social, and other issues in a global perspective. Students develop a project on a subject linked to their area of professional interest or academic specialization.

Iowa Lakeside Laboratory

(Interinstitutional Program)

Director: Arnold van der Valk

Participating Faculty: Dennis Anderson (Biology Emeritus, Humboldt State University), Richard G. Baker (Geology, University of Iowa), Neil P. Bernstein (Biology, Mount Mercy College), Lynn Brant (Earth Science, University of Northern Iowa), Lee Burras (Agronomy, Iowa State University), William G. Crumpton (Botany, Iowa State University), James Dinsmore (Animal Ecology, Iowa State University), John F. Doershuk (Anthropology, University of Iowa, and State Archaeologist), Charles Drewes (Zoology and Genetics, Iowa State University), Luis A. Gonzalez (Geology, University of Iowa), Mary A. Harris (Biological Sciences, University of Iowa), Stephen D. Hendrix (Botany, University of Iowa), Kenneth L. Lang (Biological Sciences, Humboldt State University), Michael J. Lannoo (Muncie Center for Medical Education, Ball State University), Thomas R. Rosburg (Biology, Drake University), Michael Shott (Sociology and Anthropology, University of Northern Iowa), Daryl D. Smith (Biology, University of Northern Iowa), Eugene F. Stoermer (Center for Great Lakes, University of Michigan), Lois H. Tiffany (Botany, Iowa State University), Joseph A. Tiffany (Anthropology, Iowa State University), Paul Weihe (Biology, Central College).

Iowa Lakeside Laboratory is a field station run cooperatively by Iowa State University, the University of Northern Iowa, and the University of Iowa through the State Board of Regents.

The Laboratory was established in 1909 for the conservation and study of the rich flora and fauna of northwest Iowa, especially those of the Iowa Great Lakes region with its numerous lakes, wetlands, and prairies. Its campus is located on approximately 140 acres of restored prairie, wetland, and gallery forest along the west shore of West Okoboji Lake. Lakeside's mission is to provide undergraduate and graduate students an opportunity to get hands-on experience working with a variety of natural and human environments through its field-oriented summer courses and to provide research facilities and support for graduate students and faculty working on research projects in northwestern Iowa.

Each summer, Iowa Lakeside Laboratory offers students a unique educational experience: small, full-immersion, field-oriented courses in the natural sciences (archaeology, ecology, environmental science, evolution, geology, taxonomy). All courses meet all day from Monday through Friday. The majority of courses run for either 3 or 4 weeks. Enrollments in most courses are limited to 8 to 10 students. Courses are taught at the undergraduate (sophomore and junior) and the senior/graduate level. Students obtain one credit for each week (40 hours) in class. One and two week courses are also available,

including courses designed especially for teachers. Weather permitting, students normally spend at least part of each day doing field work, either as part of their class work or working on individual or group projects. Because there are courses offered only alternate summers, the current Iowa Lakeside Laboratory Bulletin or Iowa State University Summer Session Bulletin should be consulted for the list of courses being offered in a given summer session. The Iowa Lakeside Bulletin also contains additional information about the Laboratory and about each course being offered.

Research projects by undergraduates, graduate students and faculty can be done either on the campus or at many nearby natural areas. Undergraduate and graduate students are strongly encouraged to do independent projects at Lakeside and graduate students are welcome to use it as a base for their thesis and dissertation research. Laboratory space and other facilities are available for long-term or short-term research projects.

Teaching and research facilities include eight laboratory buildings, a library, and a lecture hall. Living accommodations include cottages, motel-style units, and a large mess hall. All students are encouraged to stay at Lakeside while they are taking courses to take full advantage of its educational, professional, and social life.

Financial Aid

Iowa Lakeside Laboratory Scholarships are available to both undergraduates and graduate students. All scholarships cover room and board. Information about how to apply for Iowa Lakeside Laboratory Scholarships is included in the Iowa Lakeside Bulletin. Students should also consult the Student Financial Aid Office for other scholarship, work study, and loan programs for which they are eligible.

Registration

Students can only enroll in Iowa Lakeside courses by submitting an Iowa Lakeside Registration and Scholarship Form and Housing Form to the Iowa Lakeside Laboratory Administrative Office. These forms are found in the Iowa Lakeside Bulletin, which also contains information on current course offerings, and in the Iowa State University Summer Session Bulletin. The Iowa Lakeside Laboratory Bulletin can be obtained from:

Iowa Lakeside Laboratory
131 Bessey Hall
Iowa State University
Ames, IA 50011-1020
Phone: (515) 294-2488
FAX: (515) 294-9777
E-Mail: lakeside@iastate.edu

The entire Iowa Lakeside Bulletin is also on the World Wide Web. The URL is <http://www.public.iastate.edu/~lakeside/homepage.html>.

Early registration is advisable. Because enrollment in Lakeside courses is limited, students should register before May 1 for the following summer session. Housing is very limited and students must apply for housing or indicate

that they plan to live off campus at the time of registration.

Courses open for nonmajor graduate credit: 402I, 403I, 415I, 419I, 422I, 427I, 480I, 484I.

Courses Primarily for Undergraduate Students

la LL 205. Flora of the Iowa Lakes Region. Cr. 2. SS.

la LL 301I. Iowa Natural History. (Same as A Ecl 301I, Bot 301I, Zool 301I.) Cr. 4. Alt. SS., offered 2001. *Prereq:* One course in the biological sciences. Biological diversity and its causes examined through lectures and field trips to native lake, marsh, forest, and prairie habitats; topics include measuring the environment, sampling and identifying organisms, experimenting with the ecosystem, understanding species interactions, and appreciating influences of past and present climates and geological events on natural ecosystems of the region.

la LL 302I. Plant-Animal Interactions. (Same as Bot 302I.) Cr. 3. Alt. SS., offered 2000. *Prereq:* One course in the biological sciences. Introduction to ecology and co-evolution of plants and animals; emphasis on dispersal, pollination, and plant-herbivore interactions; field and laboratory work, reading, discussion.

la LL 303I. Undergraduate Internships. (Same as A Ecl 303I.) Cr. 1 to 5. SS. *Prereq:* Permission of instructor and sophomore standing. Placement with county conservation boards, camps, parks, etc. for experience as interpreters, rangers, and technicians.

la LL 304I. Environmental Geology of Northwest Iowa. (Same as EnSci 304I, Geol 304I.) Cr. 3. SS. An examination of basic processes that have shaped the earth's surface with emphasis on glacial, weathering, erosion, and riverine processes; the impact of land use and other human activities on contemporary landscapes; emphasis on the surficial geology of northwest Iowa.

la LL 312I. Ecology. (Same as A Ecl 312I, Biol 312I, Bot 312I, EnSci 312I, Zool 312I.) Cr. 4. SS. An introduction to the principles of ecology at the population, community and ecosystem level. Field studies of local lakes, wetlands and prairies are used to examine factors controlling distributions, interactions, and roles of plants and animals in native ecosystems.

la LL 326I. Ornithology. (Same as A Ecl 326I.) Cr. 3. SS. The biology, ecology, and behavior of birds with emphasis on field studies of local avifauna. Group projects stress techniques of population analysis and methodology for population studies.

la LL 364I. Biology of Aquatic Plants. (Same as Bot 364I.) Cr. 3. Alt. SS., offered 2001. A field-oriented introduction to the taxonomy and ecology of aquatic plants in lakes, wetlands and rivers. Individual or group projects.

la LL 367I. Plant Taxonomy. (Same as Bot 367I.) Cr. 4. SS. Principles of classification and evolution of vascular plants; taxonomic tools and collection techniques; use of keys. Field and laboratory studies emphasizing identification of local flowering plants and recognition of major plant families.

la LL 371I. Introduction to Insect Ecology. (Same as Ent 371I.) Cr. 3. Alt. SS., offered 2001. Field and laboratory study of insects, their diversity, life history; emphasis on ecology and behavior.

la LL 402I. Watershed Hydrology and Surficial Processes. (Same as Agron 402, EnSci 402I.) Cr. 4. SS. *Prereq:* Four courses in physical or biological sciences or engineering. Effects of geomorphology, soils, and land use on transport of water and materials (nutrients, contaminants) in watersheds. Field work will emphasize investigations of the Iowa Great Lakes watershed. Nonmajor graduate credit.

la LL 403I. Evolution. (Same as Biol 403I, Bot 403I, Zool 403I.) Cr. 4. SS. Mechanisms and patterns in micro-evolution and macroevolution. Field exercises will emphasize studies of natural selection, adaptation, genetic variation, and population genetics of local plant and animal populations. Nonmajor graduate credit.

la LL 415I. Freshwater Invertebrates. (Same as Zool 415I.) Cr. 3. SS. *Prereq:* One or more ecology courses. Field-oriented introduction to the identification, life-history, and ecology of common, free-living freshwater invertebrates of north-temperate lakes, rivers, and wetlands. Emphasis on the role of invertebrates in aquatic food chains and litter processing. Nonmajor graduate credit.

la LL 419I. Vertebrate Ecology and Evolution. (Same as A Ecl 419I, Zool 419I.) Cr. 4. SS. Field and laboratory study of representative vertebrates of northwestern Iowa. Observations and experimentation emphasize ecological histories by integrating concepts of functional morphology, behavioral ecology, and evolutionary biology. Nonmajor graduate credit.

la LL 422I. Prairie Ecology. (Same as Bot 422I, EnSci 422I.) Cr. 4. Alt. SS., offered 2000. *Prerequisite:* Familiarity with basic principles in biological sciences and ecology. Basic patterns and underlying physical and biotic causes of both regional and local distributions of plants and animals of North American prairies; field and laboratory analyses and projects. Nonmajor graduate credit.

la LL 427I. Archaeology. (Same as Anthr 427I.) Cr. 4. SS. Nature of cultural and environmental evidence in archaeology and how they are used to model past human behavior and land use; emphasis on Iowa prehistory; basic reconnaissance surveying and excavation techniques. Nonmajor graduate credit.

la LL 473I. Soil Genesis and Landscape Relationships. (Same as Agron 473I, EnSci 473I.) Cr. 4. Alt. SS., offered 2000. *Prereq:* Agron 154 or 402 or 402I. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use.

la LL 480I. Landscape Approaches to Environmental Planning. (Same as Env S 480I, L A 480I.) Cr. 3. SS. Translation of landscape ecological theory and practice into action plans for local communities. Case history studies of selected projects, readings from the scientific and popular literature, and lectures/workshops will be used to familiarize students with methods used to tailor planning models for local needs. Local field trips. Nonmajor graduate credit.

la LL 484I. Plant Ecology. (Same as Bot 484I.) Cr. 3. SS. Principles of plant population, community, and ecosystem ecology illustrated through studies of native vegetation in local prairies, wetlands and forests. Group or individual projects. Nonmajor graduate credit.

la LL 490I. Undergraduate Independent Study. (Same as A Ecl 490I, Biol 490I, Bot 490I, Zool 490I.) Cr. 1 to 4. SS. *Prereq:* Junior or senior classification and permission of instructor.

la LL 493. Natural History Workshop. Cr. 1 to 2. SS. Offered as demand warrants. Five day-long, non-technical introductions to a specific aspect of the natural history of the Upper Midwest or techniques for studying natural history.

- A. Amphibians and Reptiles.
- B. Birds and Birding.
- C. Nature Photography.
- D. Mushrooms and Other Fungi.
- E. Iowa's Trees and Forests.
- F. Fish Biology.
- G. Prairies and Prairie Restoration.
- H. Common Algae.
- I. Common Insects.
- J. Aquatic Plants.
- K. Life in Rivers.
- L. Life in Lakes.
- M. Mosses and Liverworts.
- N. Natural History of Iowa Great Lakes Region.
- P. Field Archaeology.
- S. Scuba Diving.
- U. Sketching Nature.

la LL 499. Undergraduate Research. Cr. 1 to 4. *Prereq:* Junior or senior classification and permission of instructor.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

la LL 501I. Freshwater Algae. (Same as Bot 501I.) Cr. 3. Alt. SS., offered 2001. Structure and taxonomy of freshwater algae based on field collected material; emphasis on genus-level identifications, habitats visited include lakes, fens, streams, and rivers; algal ecology.

la LL 503. Graduate Internships. Cr. 1 to 5. SS. *Prereq:* Permission of instructor and graduate standing. Placement with county conservation boards, camps, parks, schools, etc. for experience as interpreters, rangers, technicians, and teachers.

la LL 508I. Aquatic Ecology. (Same as A Ecl 508I, EnSci 508I.) Cr. 4. SS. *Prereq:* Courses in ecology, chemistry, and physics. Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

la LL 511I. Field Parasitology. (Same as Zool 511I.) Cr. 3. Alt. SS., offered 2001. Ecology and life history of parasites, protozoans, helminths, arthropods; field and laboratory investigations including preparation, identification, and morphology of representative types and stages; general and comparative concepts of parasitology.

la LL 520I. Fish Ecology. (Same as A Ecl 520I.) Cr. 3. Alt. SS., offered 2000. Basic principles of fish interaction with the biotic and abiotic environment. Field methods, taxonomy, and biology of fish with emphasis on the fish fauna of northwestern Iowa.

la LL 526. Advanced Field Ornithology. Cr. 2. SS. *Prereq:* Concurrent registration in 326I. Field study of birds of the upper Midwest; extended field trip to Minnesota and Wisconsin; individual or group project. Field trip fee.

la LL 531I. Conservation Biology. (Same as Bot 531I.) Cr. 3. Alt. SS., offered 2000. *Prereq:* 312I. Population- and community-level examination of factors influencing the viability of plant and animal populations from both demographic and genetic perspectives; assessment of biodiversity; design and management of preserves.

la LL 560I. Restoration Ecology. (Same as Bot 560I, EnSci 560I.) Cr. 3. Alt. SS., offered 2001. *Prereq:* A course in ecology. Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

la LL 564I. Wetland Ecology. (Same as Bot 564I, EnSci 564I.) Cr. 3. Alt. SS., offered 2000. *Prereq:* 312I. Ecology, classification, creation, restoration, and management of wetlands. Field studies will examine the composition, structure and functions of local natural wetlands and restored prairie pothole wetlands. Individual or group projects.

la LL 570. Techniques for Biology Teaching. Cr. 1 or 2 each time taken. SS. The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

- A. Animal Biology
- B. Plant Biology
- C. Fungi and Lichens
- D. Aquatic Ecology
- E. Prairie Ecology
- F. Wetland Ecology
- G. Limnology
- H. Animal Behavior
- I. Insect Ecology
- L. Leopold Education Project
- W. Project WET

la LL 575I. Field Mycology. (Same as Bot 575I.) Cr. 4. Alt. SS., offered 2000. Identification and classification of the common fungi; techniques for identification, preservation, and culture practiced with members of the various fungi groups.

la LL 580I. Ecology and Systematics of Diatoms. (Same as Bot 580I.) Cr. 4. SS. Field and laboratory study of freshwater diatoms: techniques in collection, preparation, and identification of diatom samples; study of environmental factors affecting growth, distribution, taxonomic characters; project design and execution including construction of reference and voucher collections and data organization and analysis.

la LL 590I. Graduate Independent Study. (Same as A Ecl 590I, Bot 590I, Zool 590I.) Cr. 1 to 4. SS. *Prereq:* Graduate classification and permission of instructor.

la LL 593. Natural History Workshop. Cr. 1 to 3. Offered as demand warrants. *Prereq:* Permission of instructor. Graduate workshop on some aspect of the natural history of the Upper Midwest or on techniques for studying natural history.

Courses for Graduate Students

la LL 699I. Research. (Same as A Ecl 699I, Bot 699I, Zool 699I.) Cr. 1 to 4.

Landscape Architecture

J. Timothy Keller, Chair of Department

Professors: Boon, Harvey, Hightshoe, Keller

Professors (Collaborators): Crandell

Distinguished Professors (Emeritus): Dyas

Professors (Emeritus): Lane, Rutledge

Associate Professors: Anderson, Chidister, Engler, Grundmann

Associate Professors (Collaborators): Kondolf, Patchett

Assistant Professors: Badenhope, Herrington, Martin

Assistant Professors (Adjunct): Kane, Miller, Palmer

Undergraduate Study

The profession of landscape architecture is concerned with the quality of land use. It involves analysis of environmental factors and human needs which leads to recommendations for the planning, design, management, conservation, and/or development of landscapes. The profession involves itself in a broad range of landscapes in urban, suburban, rural, and wilderness settings. The scale of such projects varies from broad regional landscape analysis and planning to detailed design.

Graduates are able to begin to apply creative and technical skills and scientific, cultural and political knowledge in the planned arrangement of natural and constructed elements on the land with a concern for the stewardship and conservation of natural, constructed, and human resources. The resulting environments shall serve useful, aesthetic, safe, and enjoyable purposes. Graduates are able to communicate clearly and work effectively with others on complex land design and planning problems. They understand the ethical, social, and environmental dimensions of issues involving manipulation of the landscape.

The curriculum is accredited by the American Society of Landscape Architects and provides the education which, combined with experience, is necessary for professional registration.

1999-2001

The curriculum is composed of a one-year pre-professional program and a four-year professional program. Admission into the professional program depends upon available resources and is subject to the approval of a faculty committee at the completion of the preprofessional program. Scholastic performance, aptitude, and personal development are the qualifications considered. The department also cooperates in the undergraduate minor in design studies.

For undergraduate curriculum in landscape architecture leading to the degree bachelor of landscape architecture, see *College of Design, Curricula*.

Graduate Study

The department offers opportunities for post-professional study leading to the degree master of landscape architecture. Minor work is offered to students taking major work in other departments.

The M.L.A. degree is granted upon completion of 36 credits and the acceptance of a thesis or creative component. Typically, the program will require four semesters of study for students with a bachelor's degree in landscape architecture. Students with a bachelor's degree in landscape architecture may also enter a special program to earn both the M.L.A. and the master of community and regional planning (M.C.R.P.) degrees in three years after completing 60 credits of study. Graduate students who do not possess a bachelor's degree in landscape architecture must complete additional coursework in the fundamental skill areas of the profession. This is accomplished by concurrent enrollment in the undergraduate program to earn the B.L.A. degree before fully engaging in graduate study. The time necessary to earn the B.L.A. in addition to the M.L.A. will vary according to the student's background upon admission. Students interested in the concurrent B.L.A./M.L.A. and double degree M.L.A./M.C.R.P. programs should write the department to receive a detailed description of requirements.

Graduates have a broad understanding of landscape architecture and related disciplines. They are able to communicate effectively with colleagues in the sciences and/or humanities as well as in the allied professions. Graduates are prepared to work individually and in multidisciplinary teams to address complex problems dealing with the physical environment. They are skilled at undertaking research and/or creative activities and communicating the results of these efforts in a concise and persuasive manner.

The department also participates in the interdepartmental minor in housing. (See *Index*.)

Courses open for nonmajor graduate credit: 302.

Courses Primarily for Undergraduate Students

L A 101. Landscape Architectural Design and Visualization I. (1-9) Cr. 4. F. *Prereq:* Concurrent enrollment in L A 141 recommended. Introduction to landscape architectural visualization and interpretation. Landscape change and precedence explored

through analytic and expressive drawings, photocopies, models and computers. Materials fee, field trip fee.

L A 102. Landscape Architectural Design and Visualization II. (1-9) Cr. 4. S. *Prereq:* 101. Introduction to landscape architectural design. Projects with an emphasis on cultural expression, environmental ethics, and technical constituents of the design process. Materials fee, field trip fee.

L A 129. Introduction to Creativity. (Same as Dsn S 129.) (3-0) Cr. 3. F. Creativity and humor in the problem solving process. The use of lateral thinking for developing new ideas. Materials fee, field trip fee.

L A 141. Introduction to Landscape Architecture. (3-0) Cr. 3. F. Overview of the profession, including: noteworthy works, areas of practice, theories, philosophies, and approaches of various landscape architects. Lectures, discussions, readings. Materials fee, field trip fee.

L A 201. Studio 1: Midwestern Landscape Studies. (1-15) Cr. 6. F. *Prereq:* Enrollment in the professional program. Investigation, analysis and documentation of the midwestern landscape. Development of aesthetic sensitivity to the geomorphology, vegetation and cultural influences on this landscape. Emphasis on "reading" and representing the region's varied landscape. Materials fee, field trip fee.

L A 202. Studio 2: Site Planning and Design I. (1-15) Cr. 6. S. *Prereq:* 201. Fundamental issues of landscape planning and design at a site scale. Projects include design for housing and other land uses. Projects encompass site analysis, precedent study, site engineering and design proposals expressed through a variety of graphic and written media. An integrated seminar component is devoted to issues relating to housing design factors, social and behavioral design factors, and open space planning. Materials fee, field trip fee.

L A 221. Native Plants of the Midwest. (2-3) Cr. 3. F. *Prereq:* Enrollment in the professional program. Observation and study of the wetland, prairie, and woodland vegetation native to the midwest region. Emphasis on plant associations - their distribution, structure, habitat and visual appearance. Plant identification and use in landscape design. Materials fee, field trip fee.

L A 272. Introduction to Landscape Architectural Theory. (3-0) Cr. 3. F. *Prereq:* Enrollment in the professional program. Introduction to landscape architecture as a mode of cultural production that shapes and is shaped by various social, political, and economic processes. Exploration of landscape as one of the most permanent, yet ephemeral repositories for this relationship. Lectures, readings, and writing. Materials fee, field trip fee.

L A 273. Landscape Architectural History: Prehistory to 1900. (Same as Dsn S 273.) (3-0) Cr. 3. S. Landscape design concepts as observed over time. Outstanding works and significant personalities from pre-history through the 19th century. Landscape design vocabulary and significant literature. Social, economic, political, and technical forces contributing to the development of landscape design styles. Lectures, readings, abstracts, reports. Materials fee, field trip fee.

L A 281. Investigating Landscape Constructions. (1-3) Cr. 2. F. *Prereq:* Enrollment in professional program. Defining landforms, watersheds, modeling of watersheds, exploring material types and their connections, weathering, and impact on natural processes such as hydrology, erosion, and sedimentation. Surface modeling. Materials fee, field trip fee.

L A 301. Site Planning and Design II. (1-15) Cr. 6. F. *Prereq:* 202. Continuation of exploration of landscape planning and design at the site scale. Students explore greater levels of design complexity and sophistication, particularly in the refinement of detail elements integrated into site-scale design proposals. Material fee, field trip fee.

L A 302. Regional Landscape Design. (1-15) Cr. 6. S. *Prereq:* 301 or permission of instructor. Land use and natural resource data used in the regional landscape planning and design process. Review of data characteristics, landscape analysis techniques, envi-

ronmental impact assessment, geographic information systems, and their applications to regional level design. Identifying opportunities and limitations of landscape characteristics in planning and design for human use. Materials fee, field trip fee. Nonmajor graduate credit.

L A 303. Landscape Design Studio. (0-12) Cr. 4 each time taken, maximum of 8. SS. *Prereq:* Enrollment in the professional program and permission of advisor. Development of solutions for landscape architectural problems at intermediate and advanced levels of design. A maximum of 8 credits may be applied towards graduation. Materials fee, field trip fee.

L A 309. Field Travel. Cr. 1 to 2 each time taken. F.S.SS. *Prereq:* Enrollment in the professional program, permission of advisor and permission of instructor. Observation of professional practice and landscapes in urban, rural, and wilderness areas. Materials fee, field trip fee. Offered on a satisfactory-fail grading basis only.

L A 321. Introduced Plants of the Midwest. (2-3) Cr. 3. F. *Prereq:* 221. Observation and study of exotic plants and horticultural varieties introduced to and cultivated in the midwest region. Emphasis on functional and aesthetic uses and cultural requirements of plants used in landscape design. Materials fee, field trip fee.

L A 341. Contemporary Landscape Architecture. (1-0) Cr. 1. S. Students assist faculty in the design of the annual lecture series for the Department of Landscape Architecture. Readings of contemporary landscape architects, coordination of guest speakers, and communication of lecture series and lecture attendance. Materials fee, field trip fee.

L A 344. Landscape Horticulture. (Same as Hort 344.) (2-6) Cr. 4. S. *Prereq:* Hort 241 or L A 321 recommended. Principles and practices of designing residential and small business landscapes. Site analysis, terrain alteration for drainage and aesthetics, functional areas and circulation, use of construction and plant materials for site development. Basic drafting, perspective drawing and plan refinement techniques. Materials fee, field trip fee.

L A 371. Landscape Architectural History: 1900 to Present. (Same as Dsn S 371.) (3-0) Cr. 3. F. Landscape design concepts as observed over time. Outstanding works and significant personalities from 1900 to the present. Landscape design vocabulary and significant literature. Social, economic, political, and technical forces contributing to the development of landscape design styles. Lectures, readings, abstracts, reports. Materials fee, field trip fee.

L A 376. Environmental Art. (Dual-listed with 576; same as Art H 376, Dsn S 376.) (3-0) Cr. 3. SS. *Prereq:* One art or design history course. Survey of environmental art, 1965-present, including earth art, public art, competitions, memorials. Materials fee, field trip fee.

L A 381. Shaping the Land. (1-3) Cr. 2. S. *Prereq:* 281. Complex land and water manipulations and its implications on the surrounding environment. Advanced surface modeling, complex grading plans. Materials fee, field trip fee.

L A 401. Community Landscape Design. (1-15) Cr. 6. F. *Prereq:* 302 or permission of instructor. Design of large urban and rural areas with emphasis on outreach, regional landscape analysis, visual resource management, impact assessment, public involvement, and land use feasibility. Design for multiple use with a basis in human ecology and landscape ecology. Master planning methods and concepts communicated through drawings, oral presentations, and written reports. Materials fee, field trip fee.

L A 402. Urban Landscape Design. (1-15) Cr. 6. F. *Prereq:* 401. Comprehensive planning and design for urban sites or for sites within urban contexts, often engaging outreach projects in Iowa communities. Projects typically include planning for a variety of integrated land uses, and cover the full range of design scales from master planning to proposals for site details. Emphasis on written and verbal as well as graphic communications. Integrated seminar component will engage topical issues in community

design, precedent studies, town planning, and urban design principles. Materials fee, field trip fee.

L A 403. Senior Thesis Preparation Tutorial. Cr. 2. F. *Prereq:* 401 and permission of instructor. Preparation for senior thesis. Materials fee.

L A 404. Advanced Landscape Architectural Design. (1-15) Cr. 6. S. *Prereq:* 402. Advanced forums for the demonstration of sophistication in landscape architectural design. Experimentation and innovation are encouraged. Materials fee, field trip fee.

L A 405. Senior Thesis. (0-15) Cr. 6. S. *Prereq:* 402, 403 and permission of advisor, chair and thesis advisor. Individual advanced forum for the demonstration of sophistication in landscape architectural design. Experimentation and innovation are expected. Materials fee.

L A 441. Professional Practice. (3-0) Cr. 3. F. *Prereq:* 482. Exploration of professional practice in the private, public, non-governmental organization and academic setting. Develop office management techniques; budgeting, scheduling; proposal preparation; construction supervision; and project management. Materials fee, field trip fee.

L A 450. Landscape Architecture Professional Internship, Study Abroad or National Student Exchange Seminar. (1-0) Cr. 1. F. *Prereq:* 302. Orientation to and preparation for L A 451. Materials fee.

L A 451. Landscape Architecture Professional Internship, Study Abroad, or National Student Exchange. Cr. R. S. *Prereq:* 401, permission of advisor and chair. Exploration of landscape architectural design, implementation and history, and theory through professional work experience, out-of-region national study experience or international study experience. Program fee.
A. Professional Internship.
B. Study Abroad.
C. National Student Exchange.

L A 471. Topical Studies in History, Theory and Criticism of Landscape Architecture. (2-0 or 3-0) Cr. 2 or 3 each time taken. F.S. *Prereq:* 371 or senior classification or graduate standing. Materials fee, field trip fee.

L A 480I. Landscape Approaches to Environmental Planning. (Same as Env S 480I, la LL 480I.) Cr. 3. SS. Translation of landscape ecological theory and practice into action plans for local communities. Case history studies of selected projects, readings from scientific and popular literature, and lectures/workshops will be used to familiarize students with methods used to tailor planning models for local needs. Local field trips. Nonmajor graduate credit.

L A 481. Landscape Construction. (1-3) Cr. 2. F. *Prereq:* 381. Solving complex site construction problems with an emphasis on the aesthetic and functional uses of building materials. Characteristics and uses of construction materials. Wood technology and structural theory, paving systems, retaining walls, site and preparation of contract documents. Materials fee, field trip fee.

L A 482. Advanced Landscape Construction. (1-3) Cr. 2. F. *Prereq:* 481. Advanced construction detailing water and irrigation systems, mechanical and electrical systems, site lighting, project scheduling, costing, final contract document preparation, with drawings and specifications. Materials fee, field trip fee.

L A 490. Independent Study. Cr. 1 to 4. F.S.SS. *Prereq:* Written approval of instructor and department chair on required form. Investigation of a topic of special interest to the student.

- A. Landscape Design
- B. Planting Design
- C. Construction
- D. History
- E. Landscape Planning
- F. Urban Design
- G. Graphics
- H. Honors
- I. Interdisciplinary Studies

- J. International Studies
- K. Computer Applications

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

L A 501. Seminar. Cr. 3. S. *Prereq:* Admission to graduate program or permission of instructor. Discussion of landscape design theories. Evaluation of how the landscape is perceived; how that perception is formed, filtered, and focused. Materials fee, field trip fee.

L A 509. Mining Reclamation and Mitigation. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* Admission to graduate program or permission of instructor. Historical and cultural attitudes toward mining and reclamation, environmental impacts of mining, mining and reclamation planning, pre-and post-mining inventories, and legal requirements for mining and reclamation. Materials fee, field trip fee.

L A 541. Principles of Research for Landscape Architects. (3-0) Cr. 3. F. *Prereq:* Admission to graduate programs or permission of instructor. Examination of research methods appropriate to landscape architectural projects, including bibliographical, historical, numerical, statistical, survey, and geographical methods. Readings, discussions, and application problems. Preparation of a research proposal. Materials fee.

L A 561. Resource Conservation and Management. (3-0) Cr. 3. F. *Prereq:* Admission to graduate program or permission of instructor. Exploration of landscape patterns and landscape ecology as a framework for land planning and use at local, regional, national, and global scales. Concepts and strategies that strive toward a sustainable earth society. Lectures, readings, reports, guest speakers. Materials fee, field trip fee.

L A 562. Studio in Resource Conservation and Management. (1-15) Cr. 6. S. *Prereq:* Admission to graduate program or permission of instructor. Developing plans and policies that feature ecological landscape description, planning, and resource conservation. Hands-on field experience with professional resource planners and managers. Materials fee, field trip fee.

L A 564. Landscape Planning for Wildlife. (2-3) Cr. 3. Alt. F., offered 2000. *Prereq:* Admission to graduate program or permission of instructor. Principles of planning wildlife habitat, greenways, corridors and reserves, wildlife habitat requirements and habitat evaluation methods for landscape architects. Planning projects, lectures, oral presentations, written reports, and field trips. Materials fee, field trip fee.

L A 572. Landscape Architectural History and Preservation. (3-0) Cr. 3. F. *Prereq:* Admission to graduate program or permission of instructor. Research methods applied to the preservation and restoration of the historic landscape. Outstanding landscape architectural works of the 18th, 19th, and 20th centuries will be used to familiarize students with methods of archaeological and documentary research, technical problems of restoration and conservation, and curatorial problems of interpretation and maintenance. Lectures, readings, abstracts, reports. Field trip fee, materials fee.

L A 573. Reading the Common Landscape. (3-0) Cr. 3. S. *Prereq:* Admission to graduate program or permission of instructor. The evolution and interpretation of the design of ordinary midwestern cultural landscapes. Emphasis on how to read the landscape as a record of social-cultural processes. Selected prototype landscapes of rural and urban Iowa and the Midwest are explored. Materials fee, field trip fee.

L A 576. Environmental Art. (Dual-listed with 376; same as Art H 576, Dsn S 576.) (3-0) Cr. 3. SS. *Prereq:* Admission to graduate program or permission of instructor. Survey of environmental art, 1965-present, including earth art, public art, competitions, memorials. Materials fee, field trip fee.

L A 580. Thesis, Creative Component Tutorial. Cr. 1 to 4. F.S.SS. *Prereq:* Permission of major professor. Hands-on participation in a creative or research

activity in the student's area of specialization. Development of a detailed prospectus that defines the thesis or creative component.

L A 582. Research Colloquium. (1-0) Cr. 1. F. *Prereq: Admission to graduate program or permission of instructor.* Examination and discussion of professional practice, research in landscape architecture, and environmental planning through research and projects by faculty in landscape architecture and related fields. Materials fee, field trip fee.

L A 590. Special Topics. Cr. 1 to 4. F.S.SS. *Prereq: Written approval of instructor and department chair on required form.*

- A. Landscape Design
- B. Planting Design
- C. Construction
- D. History
- E. Landscape Planning
- F. Urban Design
- G. Graphics
- H. Honors
- I. Interdisciplinary Studies
- J. International Studies
- K. Computer Applications

L A 599. Creative Component. Cr. var. F.S.SS. *Prereq: Permission of major professor.* Comprehensive study and original development of a project selected by the student and approved by the department. Completed project must be submitted to and approved by a graduate faculty committee as evidence of mastery of the principles of landscape architecture.

Course for Graduate Students, major or minor

L A 699. Thesis Research. Cr. var. F.S.SS. *Prereq: Permission of professor.*

Liberal Arts and Sciences Cross-Disciplinary Studies

Zora D. Zimmerman, Associate Dean for Academic Programs

Cross-disciplinary studies in the College of Liberal Arts and Sciences encompass programs of study and courses that cross established departmental lines.

Cross-Disciplinary Programs

African American Studies Program (Minor only) see *Index, African American Studies.*

American Indian Studies Program (Minor only) see *Index, American Indian Studies.*

Biological/Premedical Illustration Program (Major or minor) see *Index, Biological/Pre-Medical Illustration.*

Classical Studies (Minor only) see *Index, Classical Studies.*

Criminal Justice Studies (Minor only) see *Index, Criminal Justice Studies.*

Environmental Science (Major or minor) see *Index, Environmental Science.*

Environmental Studies (Secondary minor or major) see *Index, Environmental Studies.*

The Honors Program in Liberal Arts and Sciences see *Index, Honors Program.*

Interdisciplinary Studies Program (Major only) see *Index, Interdisciplinary Studies.*

International Studies Program (Second major or minor) see *Index, International Studies.*

U.S. Latino/a Studies Program
Program Director: H. Avalos

U.S. Latino/a Studies is devoted to the study of Mexican Americans, Puerto Ricans, Cuban Americans and other groups of people living in the United States who trace their ancestry to the Spanish-speaking countries of Latin America, and who comprise the fastest growing ethnic groups in America. U.S. Latino/a Studies is to be distinguished from Latin American studies, which focuses on people living in Latin America. The methodology of U.S. Latino/a Studies is cross-disciplinary, drawing from the methods established in anthropology, sociology, political science, economics, history, literary studies, and other fields.

In addition to the general requirements of a major in Interdisciplinary Studies, (see *Index, Interdisciplinary Studies*) a major in Interdisciplinary Studies focusing on U.S. Latino/a Studies would require the completion of 24 credit hours. At least 15 of the 24 credits must be in courses numbered 300 and above. These 24 credits in the major focusing on U.S. Latino/a Studies must include the following courses, each of which is worth three credits: LAS 211 (Introduction to U.S. Latino/a Studies), Anthr 323 (Peoples and Cultures of Latin America), Engl 344 (U.S. Latino/a Literature); Hist 441 (History of Mexico and Central America), or a course in U.S. Latino/a history, expected to be offered beginning in 1999-2000; Relig 338 (The Latino/a Religious Experience); and Soc 332 (The Latino/a Experience in U.S. Society).

The student must have an average grade of C in the required courses of the major. Fulfillment of the foreign language requirement with Spanish is strongly recommended, but not required. For a list of other eligible courses and more information on the U.S. Latino/a Studies Program, contact the program committee chair.

Linguistics Program (Major or minor; graduate minor) see *Index, Linguistics.*

Premedical and Preprofessional Health Programs see *Index, Preprofessional Study.*

Speech Communication Program see *Index, Speech Communication.*

Teacher Education Program see *Index, Teacher Education, Courses and Programs.*

Technology and Social Change

Women's Studies Program (Major or minor) see *Index, Women's Studies.*

Courses Primarily for Undergraduate Students

LAS 101. Orientation for Open Option and Preprofessional Students. (1-0) Cr. 0.5. F.S. First 8 weeks. Liberal Arts and Sciences staff. Self-responsi-

bility and university procedures. LAS general education requirements, ISU departments and programs, time management, academic study skills, adjustment to the university environment. Required of all first year students in the Open Option and Preprofessional Health Programs. Offered on a satisfactory-fail grading basis only.

LAS 104. Personal Career Development. (2-0) Cr. 2. F.S. *Prereq: 15 credits of ISU coursework.* Comprehensive approach to personal career development; intensive self-analysis; utilization of a computerized career exploration system; contact with area professionals; examination of work in modern society and the impact of technology on the future of work; exposure to job search skills necessary for career choice implementation.

LAS 111. Elementary Physical Science. (2-4) Cr. 4. S. *For students in elementary education and child development.* Topics are selected from astronomy, geology, meteorology, physics, and chemistry.

LAS 211. Introduction to U.S. Latino/a Studies. (3-0) Cr. 3. S. A survey of the people in the United States who trace their origin to the Spanish-speaking countries of Latin America, focusing principally on Mexican Americans, Puerto Ricans, and Cuban Americans. History, religion, social structure, political participation, literature, and other aspects of each group within the framework of various sociological theories of ethnic identity and relationship.

LAS 230. Third World Cultures in Global Perspective. (3-0) Cr. 3. F.S. An introduction to understanding other cultures in today's world with a focus on contemporary life, the arts, and social issues in Latin America, Asia, and Africa. Taught by a staff of cross-disciplinary faculty and international resource persons.

LAS 290. Special Problems. Cr. 1 to 3 each time taken. F.S.SS. *Prereq: Freshman or sophomore classification.* This course may be taken only with permission of the dean of the College of Liberal Arts and Sciences.

G. Catt Center Project. Cr. 1.

LAS 298. Internship/Co-op. Cr. R. F.S.SS. *Prereq: Permission of Business/Liberal Arts and Sciences Career Services and the College of Liberal Arts and Sciences; sophomore classification.* Students participating in an internship or co-op on a full-time basis must register for this course prior to beginning their work experience to remain in full-time student status.

LAS 398. Internship/Co-op. Cr. R. F.S.SS. *Prereq: Permission of Business/Liberal Arts and Sciences Career Services and the College of Liberal Arts and Sciences; junior classification.* Students participating in an internship or co-op on a full-time basis must register for this course prior to beginning their work experience to remain in full-time student status.

LAS 417. Student Teaching. (Same as C I 417.) Cr. var., each time taken. F.S. *Prereq: Engl 494, or F Lng 496, or Math 497, or Music 466, or LAS 492 or 493A and 493B, or Sp Cm 495B; admission to teacher education; approval of coordinator during semester before student teaching.* Evaluation of instruction, lesson planning, and teaching in the liberal arts and sciences.

- A. History/Social Sciences
- B. Physical Sciences
- C. Mathematics
- D. Biological Sciences
- E. English and Literature
- F. Speech Communication
- G. Foreign Languages and Literatures
- J. Earth Sciences
- K. Music—Secondary
- L. Music—Elementary
- M. Science—Basic
- N. International Student Teaching
- P. Project Opportunity Cr. 8.

LAS 480. Field Experience for Secondary Teaching Preparation. (Same as C I 480.) Cr. 1 to 2 each time taken, maximum of 2. Observation and participation in a variety of school settings after admission to the teacher preparation program. Permission of area coordinator required prior to enrollment. (S/F) grading may be used in some offer-

ings of some sections)

- A. History/Social Sciences
- B. Physical Sciences
- C. Mathematics
- D. Biological Sciences
- E. English and Literature
- F. Speech Communication
- G. Foreign Languages and Literatures
- J. Earth Sciences
- K. Music

LAS 490. Independent Study. Cr. var. F.S.SS.

Prereq: Permission of the dean of the College of Liberal Arts and Sciences. No more than 9 credits of LAS 490 may be applied toward graduation. This course may be taken only with the permission of the dean of the College of Liberal Arts and Sciences.

G.Catt Center Project

LAS 492. Methods of Teaching Science. (Same as C I 492.) (6-0) Cr. 3. F.S. First 3 weeks. *Prereq:* Admission to teacher education, 15 credits in subject-matter field. Topics include preparation for instruction, spectrum of teaching methods, motivational techniques, safety, discipline, conducting field trips, and application of teaching and learning theory. Field trips.

LAS 493. Methods of Teaching History/Social Sciences. (Same as C I 493) (3-0) Cr. 3. F.S. *Prereq:* Admission to teacher education and 30 credits in subject-matter field. Course is taught at Ames High School. Students observe classes, plan and implement lessons. Course content also includes determining appropriate learning objectives, questioning strategies, cooperative learning activities, use of technology, curriculum development, differentiating instruction, evaluation, and classroom management.

LAS 498. Internship/Co-op. Cr. R. F.S.SS. *Prereq:* Permission of Business/Liberal Arts and Sciences Career Services and the College of Liberal Arts and Sciences; senior classification. Students participating in an internship or co-op on a full-time basis must register for this course prior to beginning their work experience to remain in full-time student status.

LAS 499. Internship. Cr. 1 to 4. F.S.SS. *Prereq:* Permission of the dean of the College of Liberal Arts and Sciences. Work experience in professional setting appropriate to the student's degree program. Academic work under faculty supervision may include written projects, reports, and guided reading.

Library

Olivia M. A. Madison, Dean of Library Services

Professors: Cole, Dobson, Madison, Morris, Sage

Professors (Emeritus): Cook, Galejs, Kuhn, McNee, Yates

Associate Professors: Boydston, Gerhard, Goedeken, Gregory, Hanthorn, Jackson, Knox, Lawson, Lee, McKiernan, Osmus, Parsons, Pedersen, Pelzer, Shonrock, Wendell, Wiese, Wool, Zipp

Associate Professors (Emeritus): Mathews

Assistant Professors: Arcand, Fryer, Hobert, Kaplan, Kushkowsky, Leysen, Marinko, Niemeyer, Sickles, Stacy-Bates, Vega Garcia, Zanish-Belcher

Undergraduate Study

The library offers non-credit presentations for undergraduate students in the effective use of the library's resources. The presentations cover electronic and print sources of information in varied fields. Arrangements are made by individual course instructors.

Graduate Study

The library provides non-credit presentations to assist faculty and graduate students in the effective use of the library's research resources. The presentations cover electronic and print sources of information in varied fields. Offered F.S.SS. For more information or arrangements, call the library's Reference Information desk (294-3642).

Courses Primarily for Undergraduate Students

Lib 160. Library Instruction. (1-0) Cr. 0.5. F.S. 8 weeks. *Prereq:* for students whose native language is not English: Completion of English 101 requirement. Use of libraries and information sources, both print and electronic, including locations and services of the University Library with an emphasis on the research process. To be taken as early as possible in the student's undergraduate career. See course descriptions of Engl 105 and 105H for prerequisite related to Lib 160. Offered on a satisfactory-fail grading basis only.

Linguistics

(Interdepartmental Program)

Program Committee: D. Bratsch-Prince, J. Dow, D. Douglas, B. Schwarte, C. Thogmartin, H. Venkatagiri, J. Wagner

Undergraduate Study

The linguistics program is a cross-disciplinary program in the College of Liberal Arts and Sciences designed to meet the needs of students interested in various aspects of language—its structure, history, varieties, meanings, and uses. The program includes courses in anthropology, English, computer science, foreign languages and literatures, psychology, and speech communication, thus providing a multi-disciplinary approach to the study of human language.

Courses in linguistics serve as background for students interested in any career that involves working with language, such as anthropology, computer word processing, foreign language teaching, teaching English both as a first and as a second language, psychology, sociology, speech-language pathology and audiology.

In the College of Liberal Arts and Sciences, courses in linguistics can be applied as electives or as part of the group requirements. They may also be used in a minor or in a major.

Majors in linguistics complete a minimum of 33 hours in courses from the list below. Courses specifically required are Ling 219, 309, 371, 419, and one of the following: 420, 492, or 498. Credit for only one course in each of the following two sets may be applied toward the major: 486, 487, 524, 525, and 413, 513. To graduate with a major in linguistics, a student must earn a C (not a C-) or better in each of the courses taken to fulfill the minimum requirements of the program of study in linguistics. Students who believe they have extenuating circumstances may appeal to the chair of the supervisory committee. In addition, majors in linguistics must show proficiency in a foreign language equivalent to that

achieved after two years of university-level study.

Minors in linguistics are usually individually tailored to the interests of the student, who consults with the chair of the supervisory committee for linguistics. All minors must have a minimum of 15 credits in linguistics, of which 6 must be in courses numbered over 300. All programs must include Ling 219 or 309.

English proficiency requirement: The linguistics program requires grades of C or better in each of the following: English 104; 105 (or 105H); and one of English 305, 314, or a Foreign Language 370 course.

For information about using linguistics courses in an interdisciplinary studies major, see *Liberal Arts and Sciences, Cross-Disciplinary Studies*.

Graduate Study

A graduate minor in linguistics is offered through a cooperative agreement with the departments and programs of Anthropology, Computer Science, English, Foreign Languages and Literatures, Psychology, and Speech Communication. The minor permits students to investigate a variety of aspects of linguistics, emphasizing the ability to think about language in a systematic and disciplined way and to apply the methods of the field to research problems in their own disciplines.

For the master's degree, a declared minor consists of 9 credits in linguistics including two foundation courses (511 and either 515 or 516) and one elective from the list of courses approved for graduate credit. For the Ph.D. degree, the minor consists of 12 credits in linguistics including three foundation courses (511, 515, and 516) and one elective. It is recommended that the elective course be taken in a department other than English. Additional courses beyond those listed below may be used as electives. The chair of the supervisory committee can provide information about these.

At least one member of the linguistics faculty will serve on a student's program of study committee. A list of faculty members may be obtained from the chair of the supervisory committee. Ph.D. candidates will write one section of the preliminary examination on an area of linguistics. All students in the minor are expected to attend linguistics lectures and colloquia. Students in English with a specialization in Teaching English as a Second Language/Linguistics are not eligible for a graduate minor in linguistics.

Courses open for nonmajor graduate credit: 331, 376, 413, 420, 422, 425, 470, 471, 480, 491, 492, 494, 496, 497, 498.

Courses Primarily for Undergraduate Students

Ling 207. Introduction to Symbolic Logic. (Same as Phil 207.) See *Philosophy*.

Ling 219. Introduction to Linguistics. (Same as Engl 219.) See *English*.

Ling 220. Descriptive English Grammar. (Same as Engl 220.) See *English*.

Ling 270. Speech and Hearing Mechanism. (Same as CmDis 270.) See *Speech Communication*.

Ling 275. Introduction to Communication Disorders. (Same as CmDis 275.) See *Speech Communication*.

Ling 286. Basic Sign Language. (Same as CmDis 286.) See *Speech Communication*.

Ling 309. Linguistic Anthropology. (Same as Anthr 309.) See *Anthropology*.

Ling 325. Nonverbal Communication. (Same as ComSt 325.) See *Speech Communication*.

Ling 331. Theory of Computing. (Same as Com S 331.) See *Computer Science*. Nonmajor graduate credit.

Ling 371. Phonetics and Phonology. (Same as CmDis 371.) See *Speech Communication*.

Ling 376. Articulation and Phonological Disorders. (Same as CmDis 376.) See *Speech Communication*. Nonmajor graduate credit.

Ling 413. Psychology of Language. (Same as Psych 413.) See *Psychology*. Nonmajor graduate credit.

Ling 419. English Syntax. (Dual-listed with 516; same as Engl 419.) See *English*.

Ling 420. History of the English Language. (Same as Engl 420.) See *English*. Nonmajor graduate credit.

Ling 422. Women, Men, and the English Language. (Same as Engl 422.) See *English*. Nonmajor graduate credit.

Ling 425. Second Language Learning and Teaching. (Same as Engl 425.) See *English*. Nonmajor graduate credit.

Ling 470. Speech and Hearing Science. (Same as CmDis 470.) See *Speech Communication*. Nonmajor graduate credit.

Ling 471. Language Development. (Same as CmDis 471.) See *Speech Communication*. Nonmajor graduate credit.

Ling 480. Language Disorders. (Same as CmDis 480.) See *Speech Communication*. Nonmajor graduate credit.

Ling 486. Methods in Elementary School Foreign Language Instruction. (Same as F Lng 486.) See *Foreign Languages and Literature*.

Ling 487. Methods in Secondary School Foreign Language Instruction. (Same as F Lng 487.) See *Foreign Languages and Literatures*.

Ling 489. Undergraduate Seminar. (Same as Engl 489.) See *English*. Acceptable only when offered as a course in linguistics.

Ling 490B. Independent Study: Linguistics, Semantics. (Same as Engl 490B.) See *English*.

Ling 490D. Independent Study: Linguistic Anthropology. (Same as Anthr 490D.) See *Anthropology*.

Ling 491. French Linguistics. (Same as Frnch 491.) See *Foreign Languages and Literatures*. Nonmajor graduate credit.

Ling 492. History of the Romance Languages. (Same as F Lng 492.) See *Foreign Languages and Literatures*. Nonmajor graduate credit.

Ling 494. Hispanic Dialectology. (Same as Span 494.) See *Foreign Languages and Literatures*. Nonmajor graduate credit.

Ling 496. Contrastive Analysis of Spanish/English Syntax. (Same as Span 496.) See *Foreign Languages and Literatures*. Nonmajor graduate credit.

Ling 497. Spanish Linguistics. (Same as Span 497.) See *Foreign Languages and Literatures*. Nonmajor graduate credit.

Ling 498. History of the Germanic Language. (Same as F Lng 498.) See *Foreign Languages and Literatures*. Nonmajor graduate credit.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Ling 500. Language and Culture. (Same as Anthr 500.) See *Anthropology*.

Ling 511. Introduction to Linguistic Analysis. (Same as Engl 511.) See *English*.

Ling 512. Linguistic Change in English: Historical Analysis of Literary and Non-Literary Texts. (Same as Engl 512.) See *English*.

Ling 514. Language in Society. (Same as Engl 514.) See *English*.

Ling 515. Applied Phonology. (Same as Engl 515.) See *English*.

Ling 516. English Syntax. (Dual-listed with 419; same as Engl 516.) See *English*.

Ling 517. Theories of Second Language Acquisition. (Same as Engl 517.) See *English*.

Ling 518. Teaching English as a Second Language: Methods and Materials. (Same as Engl 518.) See *English*.

Ling 520. Pedagogical Analysis of English. (Same as Engl 520.) See *English*.

Ling 524. Methods in Teaching Reading and Writing Skills to Nonnative Speakers of English. (Same as Engl 524.) See *English*.

Ling 525. Methods in Teaching Listening and Speaking Skills to Nonnative Speakers of English. (Same as Engl 525.) See *English*.

Ling 526. Computer Assisted Language Learning. (Same as Engl 526.) See *English*.

Ling 527. Discourse Analysis. (Same as Engl 527.) See *English*.

Ling 590. Special Topics. (Same as Anthr 590.) See *Anthropology*. Acceptable only when taught as a course in linguistics.

Ling 590B. Special Topics: Teaching English as a Second Language (TESL)/Linguistics. (Same as Engl 590B.) See *English*.

Ling 591. Studies in Applied Linguistics. (Same as Engl 591.) See *English*.

Management

Charles B. Shrader, Chair of Department

Distinguished Professors: Wortman

Professors: Chacko, Hunger, McElroy, Morrow, Shrader

Associate Professors: Aitchison, Blackburn, Johnson, Van Auken, Werbel

Assistant Professors (Adjunct): Sharp

Undergraduate Study

For undergraduate curriculum in business, major in management, see *College of Business, Curricula*.

The Department of Management offers a major in management. Students will complete the general education requirements (including business foundation courses), and business core requirements for the bachelor of science degree (B.S.).

Management is a broadly defined discipline and activity, which is neither industry nor function specific. Management concepts, theories, techniques, and skills are applicable to all business functional areas and are essential components for successful organizations. Management requires sound conceptual, technical, and human skills for the effective utiliza-

tion of organizational resources. The management major at Iowa State University encompasses the diversity of these skills by providing students with alternative programs of study from which they can select a curriculum that most closely matches their academic interests and career opportunities. Within the management major, students can select either general business option or choose one of two specialized curricula: entrepreneurship and strategy or human resources management.

The **general business option** enables students to gain a broad understanding of the functional areas of business. Students selecting this option are required to take the following five courses: Acct 383, Fin 352, Mgmt 371, Mkt 447, and Mgmt 471. These required courses are designed to expose a student to the technical, behavioral, and functional nature of businesses and the integrative nature of management. In addition, students choose one course from an approved list to round out the 18-credit major. Students may also choose to utilize elective credits to take other courses that are of interest beyond the 18 required credits.

The **entrepreneurship and strategy option** is designed for students interested in acquiring the technical and behavioral skills associated with managing new and small businesses. Students are required to take Mgmt 310 and 377, as well as either Mgmt 413 or 415. Also, students select three additional courses from an approved list to complete the 18-credit major. These three choice classes are designed to enable the student to tailor the major to their specific areas of interest.

The **human resources management option** allows students to focus on behavioral and labor issues surrounding the management of people in organizations. Students choosing the option are required to take Mgmt 371 and 471, plus four additional courses selected from an approved list.

Graduate Study

The Department of Management participates in three graduate programs: the M.S. in Business Administrative Sciences, the M.B.A. full-time and part-time programs, and the interdisciplinary M.S. degree in Industrial Relations. The M.S. in Business Administrative Sciences is a 30-credit curriculum culminating in a thesis. The M.B.A. program is a 48-credit hour curriculum. Twenty four of the 48 credit hours are core courses and the remaining 24 are graduate electives. Finally, the department is one of several participating departments offering coursework leading to an interdisciplinary M.S. in industrial relations.

Fully-admitted M.B.A. degree candidates with previous business study as an undergraduate may qualify for advanced entry into the M.B.A. programs. Advanced entry is designed to serve those students with a bachelor's degree in business as they may complete the M.B.A. degree program requirements in as few as 30 semester credit hours. Information about the advanced M.B.A. entry application process can be obtained in the College of Business Graduate Programs Office, 218 Carver Hall.

Courses open for nonmajor graduate credit: Mgmt 413, 414, 415, 472, 479.

Courses Primarily for Undergraduate Students

Mgmt 310. Entrepreneurship and Innovation. (3-0) Cr. 3. F.S. *Prereq:* *Econ 101; Acct 284 or permission of instructor.* Review of the entrepreneurial process with emphasis on starting a new business. How to analyze opportunities, develop an innovative product, organize, finance, market, launch, and manage a new venture. Deals with the role of the entrepreneur and the importance of a business plan. Speakers and field project.

Mgmt 313. Feasibility Analysis and Business Planning. (3-0) Cr. 3. S. *Prereq:* 310. Not available for credit to business students. Developing an idea for a new business venture, conducting a feasibility study, researching the potential market, analyzing the competition, and writing a formal business plan. Basic business functions are discussed in terms of their application to conducting feasibility analysis and writing a business plan for an entrepreneurial venture.

Mgmt 370. Management of Organizations. (3-0) Cr. 3. F.S.SS. *Prereq:* *Econ 101.* A management functions approach is used to explain what managers do in organizations; how they deal with external constituents, how they structure their companies, and how they deal with employees. A contingency approach is used as a framework for understanding how to increase the effectiveness and efficiency of organizations in today's dynamic, highly competitive business environment.

Mgmt 371. Organizational Behavior. (3-0) Cr. 3. F.S. *Prereq:* 370. The study of individual attributes, interpersonal relations, and employee attitudes in organizations. Instructional emphasis is placed on how management concepts such as reward systems, job design, leadership, teams, etc. can be used to manage employee attitudes and behavior.

Mgmt 377. Competitive Strategy. (3-0) Cr. 3. F. *Prereq:* *Econ 101.* Developing competitive strategy and achieving competitive advantage in firms, including: industry analysis, generic strategies, hypercompetition, competing against time, and building distinctive capabilities.

Mgmt 413. Entrepreneurial Management in New and Existing Businesses. (3-0) Cr. 3. F.S. *Prereq:* 310, 377; *Mkt 340; Fin 350.* Initiating, acquiring, and building an entrepreneurial activity either within or outside existing businesses. Emphasis is on conducting a feasibility study and on proposing a realistic business plan for a new venture. Managing an entrepreneurial activity for sustained success. Nonmajor graduate credit.

Mgmt 414. International Management. (3-0) Cr. 3. F. The nature and economic role of the multinational firm and entrepreneurial ventures, including the impact of legal, political, and cultural variables upon firm performance and managerial activity; case studies illustrate interdependent nature of functional areas of business projected across national boundaries. Nonmajor graduate credit.

Mgmt 415. Dynamics of Small Business Management. (3-0) Cr. 3. F.S. *Prereq:* 370; *Mkt 340; Fin 350; TrLog 360, POM 320.* Examination of small business problems and issues. Emphasis is on analyzing existing small and family-owned businesses and includes a field project. Nonmajor graduate credit.

Mgmt 419. Social Responsibility of Business. (3-0) Cr. 3. S. A consideration of the role of business in society. Critical analysis of ethical, managerial, and public issues as they affect the corporation.

Mgmt 471. Personnel and Human Resource Management. (3-0) Cr. 3. F.S. *Prereq:* *Junior standing.* Recruitment and selection, utilization, and development of people in organizations. Examination of each personnel function; interrelationships among the functions.

Mgmt 472. Diverse Identities at Work. (3-0) Cr. 3. F.S. *Prereq:* *Junior classification.* Exploration of work relationships among individuals and groups in organizations. Attention to cultural identity and inequality.

Emphasizes gender, race, and class. Involves student participation in self-study groups. Nonmajor graduate credit.

Mgmt 478. Business Policy and Strategic Management. (3-0) Cr. 3. F.S.SS. *Prereq:* 370; *POM 320; Fin 350; Mkt 340; TrLog 360, graduating senior.* Strategy formulation, implementation, and evaluation and control in today's organizations. Emphasis is on strategic planning and decision making using the case method and/or projects.

Mgmt 479. Management Seminar. (3-0) Cr. 3. S. *Prereq:* *Senior classification in management and permission of the instructor.* Discussion of new or controversial issues in management. Course utilizes advanced material and research drawn from topic areas within management. Nonmajor graduate credit.

Mgmt 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq:* 370, *senior classification, permission of instructor.*

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Mgmt 501. Strategy Formation. (1-0) Cr. 1. F. *Prereq:* *Graduate classification.* An introduction to the strategic planning process. How to formulate strategy in context of environmental opportunities and threats, how to analyze industry competition and build competitive advantages.

Mgmt 507. Organizational Behavior. (2-0) Cr. 2. F. *Prereq:* *Graduate classification.* Understanding human behavior in organizations and the nature of organizations from a managerial perspective. Special emphasis is placed on how individual differences, such as perceptions, personality, and motivation, influence individual and group behavior in organizations and on how behavior can be influenced by job design, leadership, groups, and the structure of organizations.

Mgmt 511. Ethics and Social Responsibility. (1-0) Cr. 1. S. *Prereq:* *Graduate classification.* The ethical issues, moral dilemmas, and stakeholder responsibilities embraced by today's corporate decision makers. The morality of current management models and practices. Corporate governance and control, moral reasoning in groups, whistleblowing, employee safety, truth in advertising, environmental pollution, plant closings, insider trading, employee rights.

Mgmt 512. Strategic Management. (2-0) Cr. 2. S. *Prereq:* 501, 507, *POM 502, MIS 503, Mkt 504, Fin 505, Acct 508.* Critical analysis of case studies in strategic management with an emphasis on integrative decision making. Strategy implementation in light of the legal, regulatory, economic, social, and political contexts of business.

Mgmt 566. Entrepreneurship and New Business Creation. (3-0) Cr. 3. *Prereq:* 512. The essentials of starting and operating a new business. Topics include current research on entrepreneurial perspective, starting and developing a new business, financing the venture, managing the growing firm, and special issues.

Mgmt 570. Managing Employee Attitudes and Behaviors. (3-0) Cr. 3. F.SS. *Prereq:* 371 or 507 or *Psych 450.* Advanced topics germane to the management of individuals and groups over their work lives; sustained work commitment, motivation and job/career satisfaction, absenteeism, turnover, stress, leadership and career development (e.g., career ladders, mentoring).

Mgmt 571. Seminar in Personnel and Human Resources Management. (3-0) Cr. 3. S. *Prereq:* 371 or 507 or *Soc 420.* Topics and issues in personnel management with a focus on the management of human resources in organizations. Current personnel practices, philosophies, and behavioral science research.

Mgmt 573. Employment Law for Managers. (3-0) Cr. 3. *Prereq:* *Graduate classification.* Survey of employment law for managers. Topics include: hiring employees, employment practices (e.g., handbooks, harassment, drug testing, discipline), union relations, and termination of employment (e.g., COBRA).

Mgmt 575. Compensation Management. (3-0) Cr. 3. F. *Prereq:* 571. Concepts, techniques, and issues dealing with remuneration of the work force. The impact of government legislation as well as organizational and societal issues.

Mgmt 576. Contemporary Topics in Agribusiness Management I. (Same as BusAd 576.) (3-0) Cr. 3. F. *Prereq:* *Graduate classification.* Survey of contemporary issues in agribusiness management including theory, techniques, and practices. Emphasis on nature of agribusiness management, changing structures of agribusiness, and relationship of business functions.

Mgmt 577. Contemporary Topics in Agribusiness Management II. (Same as BusAd 577.) (3-0) Cr. 3. S. *Prereq:* *Graduate classification.* Critical analysis of specific issues in agribusiness management with emphasis on environmental impact of agribusiness, impact of international competition, structure of agribusiness firms, relationship to agricultural biotechnology, and rural entrepreneurship.

Mgmt 581. Strategic Planning and Environmental Analysis. (3-0) Cr. 3. F. *Prereq:* 501 or *permission of instructor.* Discussion of concepts and techniques used in long range strategic planning. Examination of planning practices in business and not-for-profit organizations. Topics include environmental scanning, industry analysis, forecasting, corporate and competitive strategies, and tactics.

Mgmt 590. Special Topics. Cr. 1 to 3 each time taken. F.S.SS. *Prereq:* *Permission of instructor.* For students wishing to do individual research in a particular area of management.

Management Information Systems

(Administered by the Department of Logistics, Operations and Management Information Systems)

Michael R. Crum, Chair of Department Distinguished Professors: Allen, Baumel

Professors: Crum, Poist, Wacker

Professors (Emeritus): Thompson, Voorhees

Associate Professors: Chu, Nilakanta, Norris, Premkumar, Walter

Assistant Professors: Goldsby, Hendrickson, Johnson, Strader, Suzuki, Zhu

Instructors (Adjunct): Blanshan, Choobineh

Undergraduate Study

For undergraduate curriculum in business, major in management information systems, see *College of Business, Curricula.*

The M.I.S. Program is designed to provide students with a strong educational foundation that prepares them as information system (IS) professionals. The academic program consists of a specially designed curriculum that emphasizes conceptual, analytical, technical and interpersonal skills. The major offers students comprehensive training in the application, use and management of information systems to prepare them to provide effective information services and support to organizations. The coursework is designed to provide the technical and conceptual skills associated with the use of information technology in business organizations. The program will: impart knowledge on existing and emerging information

technologies and their impact on the IS function; train to critically analyze business processes, identify inefficiencies and problems, assess information requirements, create business solutions and technical specifications for the supporting system; provide expertise to design and develop database applications using the latest database technologies; provide expertise in the latest telecommunication technologies; train in interpersonal and communication skills to effectively interact with various information systems' clients; and provide managerial skills to manage IS projects.

The MIS major requires students to take six courses. The required courses are: Com S 201, MIS 331, MIS 432, MIS 433, and MIS 435. In addition they will take one additional elective course from an approved list. These courses are designed to provide the conceptual, technical, and managerial skills necessary to design and develop systems in organizations.

Graduate Study

The MIS area participates in two graduate programs in the College of Business—M.S. in Business Administrative Sciences, and full-time and part-time M.B.A. programs. The M.S. program is a 30 credit hour curriculum with a thesis.

The M.B.A. program is a 48 credit hour curriculum. Twenty-four of the 48 credit hours are core business courses and the remaining 24 credit hours are graduate electives. Students can obtain a MIS specialization in the M.B.A. program by taking 12 credit hours of graduate MIS courses from a selected list of courses.

Fully-admitted M.B.A. degree candidates with previous business study as an undergraduate may qualify for advanced entry into the M.B.A. program. Advanced entry is designed to serve those students with a bachelor's degree in business as they may complete the M.B.A. degree program requirements in as few as 30 semester credit hours. Information about the advanced entry M.B.A. application process can be obtained from the College of Business, Graduate Programs Office in 218 Carver Hall.

Courses open for nonmajor graduate credit: MIS 432, MIS 433, MIS 435 and MIS 438.

Courses Primarily for Undergraduate Students

MIS 230. Applications in Information Systems. Cr. 1 to 3. Training in IS software and applications, and problem solving in functional business areas.

MIS 330. Management Information Systems. (3-0) Cr. 3. *Prereq: Com S 103 or equivalent.* The role of information technology in organization. Overview of methodologies for design and development of systems including decision support systems, expert systems, data bases, end-user computing, etc. Computer applications relate concepts to practice. Lecture and laboratory work emphasizes the enabling role of IT in contemporary organizations.

MIS 331. File Structures and Programming. (3-0) Cr. 3. *Prereq: 330, Com S 207.* Introduction to the concepts and use of data structures, file accesses and object oriented programming methodologies in contemporary business environments. Object oriented programming languages such as C++ used. Embedded features of SQL and other application development environments will also be covered.

MIS 432. Information Systems Analysis. (3-0) Cr. 3. *Prereq: 330, Com S 201.* Critical analysis of business processes, data and process modeling, feasibility studies, CASE tools, and developing system design specifications. Nonmajor graduate credit.

MIS 433. Database Management Systems. (3-0) Cr. 3. *Prereq: 331.* Database design, development, and implementation. Focus on data models, both classical and object oriented. Uses relational and/or object oriented database management systems. Nonmajor graduate credit.

MIS 435. Business Telecommunications. (3-0) Cr. 3. *Prereq: 331.* Overview of communications technology used in various business applications - local area network, wide area network, broad band network, wireless and voice network. Understand the role of protocols, particularly internet protocols, in communications. Train to analyze network requirements, design and implement local area networks. Nonmajor graduate credit.

MIS 436. Information Systems for Entrepreneurs. (3-0) Cr. 3. *Prereq: 330.* Only for non-MIS majors. Provides the basic skills to manage a small IS operation in a small business/new venture. Topics will focus on small IS operations. Training will be provided on basics of hardware/software, databases, networking, and common small business IS applications.

MIS 438. Information Systems Development. (3-0) Cr. 3. *Prereq: 432, 433.* Design of business systems using contemporary tools and methods such as SQL, CASE tools, OOD tools, etc. Focuses on synthesizing concepts from earlier MIS courses. Nonmajor graduate credit.

MIS 439. Topics in Management of Information Systems. (3-0) Cr. 3. *Prereq: 331, permission of instructor.* A variety of topics will be covered and topics may vary between semesters. Some of the topics are information resources management, electronic commerce, decision support systems, and expert systems.

MIS 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq: 330, senior classification, permission of instructor.*

Courses Primarily for Graduate Students. Open to Qualified Undergraduate Students

MIS 503. Management Information Systems. (2-0) Cr. 2. *Prereq: Graduate classification.* Current theories and practices of information processing and decision making. Focus on information technology and its uses in improving work practices, products, and tools for decision support. Use of artificial intelligence and other developments in technology. Competitive pressures and risks of information technology (IT). Setting IT strategy, information system planning and development of enterprise architecture. Focus on systems development and implementation.

MIS 531. Business Software Development. (3-0) Cr. 3. *Prereq: 503 or equivalent.* A survey of business-oriented programming languages with emphasis on design, writing, debugging and testing of computer programs for business transaction processing, and managerial decision-support. Topics include structured programming and file processing.

MIS 533. Data Management for Decision Makers. (3-0) Cr. 3. *Prereq: 503 or equivalent.* The course will address the data needs of functions such as marketing, finance, production etc. The course will focus on teaching advanced data base management skills needed to design, develop and use database, data warehousing and data mining systems for effective decision support. Importance of contemporary technologies will be stressed.

MIS 535. Telecommunications Management. (3-0) Cr. 3. *Prereq: 503 or equivalent.* Issues involved in the management of telecommunications function. Overview of communications technology used in various business applications, local area network, wide area network, broad band network, wireless and voice networks. Internet technologies and protocols. Analyzing the strategic impact of these technologies

on organizations. Strategic planning for telecommunications, including network planning and analysis.

MIS 538. Business Processes and Systems Development. (3-0) Cr. 3. *Prereq: 503 or equivalent.* Discusses the theory and techniques used to analyze information systems to support various business processes. The course also discusses the theory and concepts related to business systems design such as data and process modeling, relational data base theory, database management, systems design, and developing technical specifications for a business system. A working prototype for a business application will be developed using popular software development packages.

MIS 539. Topics in Management of Information Systems. (3-0) Cr. 3. *Prereq: 503 or equivalent.* A variety of topics may be offered in different semesters. Topics may include electronic commerce, information resources management, decision support systems, and expert systems.

MIS 590. Special Topics. Cr. 1 to 3 each time taken. *Prereq: Permission of instructor.* For students wishing to do individual research in a particular area of MIS.

Marketing

Charles B. Shrader, Chair of Department

Distinguished Professors: Teas

Professors (Emeritus): Zober

Associate Professors: Agarwal, Lacznik, Ramaswami, Wong

Assistant Professors: Barone, DeCarlo, Kempf, Palan

Instructors (Adjunct): Harms

Undergraduate Study

For undergraduate curriculum in business, major in marketing, see *College of Business, Curricula.*

In addition to the business core, marketing majors are required to complete 18 credits of marketing or department-approved courses. Included in these 18 credits are three required courses: Mkt 443, 444, and 447.

Marketing is concerned with management decisions that deal with the satisfaction of customer needs and wants in the purchase and use of goods and services. The primary decision areas in marketing involve the identification of market segments and decisions dealing with product design, pricing, promotion (including personal selling), and distribution. A major in marketing prepares the student for careers in selling and sales management, marketing research, marketing management, retailing, promotion management, and international marketing. Each field of study may be applied to consumer, industrial, and service marketing in business and nonprofit organizations.

The instructional objective of the Marketing department is to provide knowledge of the marketing process and an understanding of the marketing function. The students are expected to develop decision-making skills, computational skills, and communication skills with appreciation for global marketplace and ethical concerns.

Graduate Study

The Department of Marketing participates in two graduate programs: the M.S. in Business Administrative Sciences and the M.B.A. full-time and part-time programs. The M.S. in business administrative sciences is a 30-credit curriculum culminating in a thesis or creative component. The M.B.A. program is a 48-credit, nonthesis, noncreative-component curriculum. Twenty four of the 48 credit hours are core courses and the remaining 24 are graduate electives. Within the M.B.A. program, students may develop an area of specialization in marketing. This specialization requires that 12 of the 24 credit hours of graduate electives be from marketing.

Fully-admitted M.B.A. degree candidates with previous business study as an undergraduate may qualify for advanced entry into the M.B.A. program. Advanced entry is designed to serve those students with a bachelor's degree in business as they may complete the M.B.A. degree program requirements in as few as 30 semester credit hours. Information about the advanced M.B.A. entry application process can be obtained in the College of Business Graduate Programs Office, 218 Carver Hall.

Courses open for nonmajor graduate credit: 444, 448, 449 and 492.

Courses Primarily for Undergraduate Students

Mkt 340. Principles of Marketing. (3-0) Cr. 3. F.S.SS. *Prereq: Econ 101.* The role of marketing in society. Markets, marketing institutions, and marketing functions with emphases on product, price, marketing communication, and marketing channel decisions.

Mkt 341. Marketing Management for Nonbusiness Students. (3-0) Cr. 3. F.S. *Prereq: 340.* Introduction to use of marketing techniques in analysis of business decisions dealing with pricing, advertising, personal selling, product development, and channels of distribution. (For nonbusiness students only.)

Mkt 343. Personal Sales. (3-0) Cr. 3. *Prereq: 340.* Fundamentals of personal sales with emphasis on the importance of self-confidence, control in human interactions, and sales techniques; simulations of selling situations.

Mkt 410. Promotional Strategy. (3-0) Cr. 3. F.S. *Prereq: Credit or enrollment in 447.* Principles, concepts, and problems involved in development and management of promotion. Coordination of a variety of promotional elements: advertising, personal sales, public relations, and sales promotions.

Mkt 442. Sales Management. (3-0) Cr. 3. F.S. *Prereq: 340.* Functional aspects of sales force management; personal selling methods; procedures for recruiting, selecting, and training new salespeople; compensation and expense control systems; problems of sales force motivation and supervision; methods of territorial and quota assignment; sales department budgets; distributor-dealer relations; other selected topics.

Mkt 443. Strategic Marketing Management. (3-0) Cr. 3. F.S. *Prereq: 444, 447.* Analysis of major elements of strategic marketing management. May include case studies or business simulations involving decision making using marketing tools from previous courses. (For marketing majors only.)

Mkt 444. Fundamentals of Marketing Research. (3-0) Cr. 3. F.S. *Prereq: 340, Stat 101 or 227.* Marketing research techniques: problem formation, research design, questionnaire construction, sampling, data collection procedures, and analysis and interpretation of data related to marketing decisions. Nonmajor graduate credit.

Mkt 446. Retailing. (3-0) Cr. 3. F.S. *Prereq: 340.* Basic areas of retail management: buying, merchandising, retail promotion, store location, store layout, credit management, and inventory control. Emphasis on practical application of retail management principles.

Mkt 447. Fundamentals of Consumer Behavior. (3-0) Cr. 3. F.S. *Prereq: 340.* Study of how consumers select, purchase, use, and dispose of goods and services. Includes analyses of how markets and others influence these processes. Application of concepts and methods of the behavioral sciences to marketing management decision making.

Mkt 448. Fundamentals of International Marketing. (3-0) Cr. 3. F.S. *Prereq: 340.* Introduction to terms used in international marketing and sources of information on international markets. Development of sensitivity toward foreign business environment and familiarity with operations of multinational corporations. Nonmajor graduate credit.

Mkt 449. Marketing Seminar. (3-0) Cr. 3. *Prereq: 340 and permission of instructor.* Analysis of current issues and problems in marketing with emphasis on new theoretical and methodological developments. Additional seminars may be offered. Nonmajor graduate credit.
A. Health-Care Marketing
B. Services Marketing

Mkt 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq: 340, senior classification; permission of the instructor.*

Mkt 492. Comparative Marketing. (3-0) Cr. 3. SS. *Prereq: 340.* The course is designed to provide experience to students in culture, social, economic, and political environment of marketing in a foreign country. Students complete a term project (e.g., a marketing plan) based on information collected in the foreign country. Students attend briefings by experts/officials of private and public organizations. Nonmajor graduate credit.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Mkt 504. Marketing. (2-0) Cr. 2. *Prereq: Graduate classification.* The scope of marketing and the identification and assessment of marketing opportunities. Consumer behavior and decision making process, organizational buyer behavior, and the role of research in the marketing planning process. Market definition and analysis, segmentation, competitor analysis, targeting and strategic decisions involved in developing the marketing program. Developing marketing mix strategies and relating them to the overall strategic marketing plan. Organizational design for marketing strategy implementation and control, and effectiveness.

Mkt 509. International Business. (2-0) Cr. 2. *Prereq: Graduate classification.* Survey of the structure and environment of international business. Patterns of international trade, economic and monetary systems, cross-cultural and legal aspects of international business. Global dimensions of the functional disciplines of business. Tools for developing global strategies such as economic analysis and risk analysis.

Mkt 540. Marketing Management. (3-0) Cr. 3. F.S. *Prereq: 504.* Strategic marketing and decision making, with emphasis on cases utilizing qualitative and quantitative techniques and marketing models.

Mkt 541. International Marketing. (3-0) Cr. 3. F.S. *Prereq: 504, 509.* Scope and nature of global marketing operation; the context of international environment in which firms operate. Recent developments of international business activities, and a framework for better understanding of the basic forces driving international business and marketing operations. Development of market entry strategies and global marketing mix policies, as well as export operations. Organizational issues related to the globalization of the firm.

Mkt 542. Product Policy and Strategy. (3-0) Cr. 3. S. *Prereq: 504.* Principles and concepts of new product development and introduction; decision areas include market definition and structure, idea genera-

tion, concept evaluation, test marketing, launch tracking, and global product planning; models and techniques of new product evaluation used by consumer product companies.

Mkt 544. Marketing Research. (3-0) Cr. 3. S. *Prereq: 504, Stat 328 or 401.* Marketing research methods are examined with emphasis on the use of advanced research methods in business research. Application of advanced sampling, measurement, and data analysis methods in research on market segmentation, market structure, consumers' perceptions and decision processes, marketing communication, new product development, and pricing.

Mkt 547. Consumer Behavior. (3-0) Cr. 3. S. *Prereq: 504.* The behavior of consumers. Intensive review of literature from relevant disciplines. Applications of concepts and methods of the behavioral sciences to marketing management decision making.

Mkt 590. Special Topics. Cr. 1 to 3 each time taken. *Prereq: Permission of instructor.* For students wishing to do individual research in a particular area of marketing.

Materials Engineering

Undergraduate Study

For the undergraduate curriculum in materials engineering leading to the degree bachelor of science, see College of Engineering, Curricula. The Materials Engineering degree is a combination of two ABET accredited degree programs in Ceramic Engineering and Metallurgical Engineering.

Materials Engineering is a broadly-based discipline relating the composition, microstructure, and processing of materials to their properties, uses and performance. Materials Engineering includes a variety of traditional and modern technologies involving metals, ceramics, polymers, electronic materials, and their composites.

Because of its interdisciplinary nature, career opportunities for Materials Engineers bridge all industrial and government sectors including: materials based technologies (production of steel, glass, plastic), communication/information technologies (semiconducting materials, fiber optics), medical/environmental technologies (biomedical energy production, waste containment), consumer products (building and construction, durable goods), and transportation products (automotive, aerospace).

In addition to those skills demonstrated by all ISU engineering graduates. Materials Engineering graduates are able to apply scientific and engineering principles to select or design the best materials to solve engineering problems. They are also able to control the microstructure of materials through processing to optimize properties and performance. They are skilled in creative, independent problem solving under time and resource constraints. Graduates will have gained experience in materials engineering practice through cooperative work experience or internships in industry, national laboratories, or other funded research work. They will have hands-on skills with a broad range of modern materials processing and characterization equipment and methods.

A degree in Materials Engineering relies on a strong foundation of math, chemistry and physics. The core materials courses include fundamentals of materials, kinetics and thermodynamics, mechanical properties, computational methods, and design experience throughout the program (beginning in the sophomore year). Students tailor their programs to their goals and interests through the selection of two areas of specialization from the four available: ceramic materials, electronic materials, metals and polymers. Additional technical electives can be taken in other areas of interest. The breadth and depth of the program provide excellent preparation for both immediate entry into industry or further study in graduate school.

The department also offers a cooperative education program that combines classroom learning with work experience. (See *College of Engineering Cooperative Programs*).

Courses open for nonmajor graduate credit: All 300 or 400 level courses except 313, 396, 397, 398, 413, 414, 490, 497, 498.

Courses Primarily for Undergraduate Students

Mat E 207. Introductory Physical Metallurgy Laboratory. (1-2) Cr. 2. S. *Prereq: Credit or enrollment in 211.* Electrical properties of metals, powder x-ray diffraction, temperature measurement, hardness and tensile testing, metallography (light microscopy) of ferrous and phase transformations. Materials degradation. Materials selection.

Mat E 211. Introduction to Materials Science and Engineering. (4-3) Cr. 5. F. *Prereq: Chem 177 or 167.* Structure and properties of ceramic, electronic, polymeric and metallic materials, emphasizing differences based on structure and bonding. Phase equilibria and phase transformations. Materials degradation. Materials selection.

Mat E 212. Thermodynamics in Materials Engineering. (3-0) Cr. 3. S. *Prereq: Chem 178 and credit or enrollment in Math 266 and Phys 222.* Basic laws of thermodynamics applied to materials systems. Thermodynamics of chemical reactions. Homogeneous and heterogeneous equilibrium. Phase diagrams for materials systems.

Mat E 213. Integrated Materials Design. (0-3) Cr. 1. F. *Prereq: Credit or enrollment in 211.* Design of devices, parts, processes or systems (including experiments) taking into account physical, chemical, mechanical, economic and ethical principles. Project planning, including scheduling and cost estimation. Application of design tools such as CAD, CAM and FEM. Analysis of problems, design and development of solutions. Safety, concept of shared responsibility, teamwork, communication. Testing and data collection. Interpretation of results and reporting. Oral presentation skills.

Mat E 214. Structural Characterization of Materials. (1-6) Cr. 3. S. *Prereq: Credit or enrollment in Phys 221.* Structural characterization of ceramic, electronic, polymeric and metallic materials. Techniques include optical and electron microscopy, x-ray diffraction, and thermal analysis techniques. Identification of materials type, microstructure, and crystal structure.

Mat E 272. Principles of Materials Science and Engineering. (2-0) Cr. 2. F.S. Introduction to the structure of metals, polymers and ceramics. Crystal structure and imperfections in metals. Diffusion, mechanical properties, and failure mechanisms. Phase equilibrium diagrams and heat treatment principles for steels, cast irons, and aluminum alloys. Corrosion and electrical properties. Engineering applications.

Mat E 273. Materials for Aerospace Applications. (3-0) Cr. 3. F. *Prereq: Chem 167 or 177, E M 324.* Introduction to composite materials, high-perfor-

mance adhesives, and bonding. Fundamentals of processing, fabrication, and properties of lightweight, load-bearing materials. Control of mechanical properties. Selection of materials to meet functional, environmental, economic, processing, and product design requirements. Review of selected industry case histories. Emphasis on aerospace applications and design.

Mat E 297. Engineering Internship. Cr. R. F.S. *Prereq: Permission of department: sophomore classification.* Professional work period, one semester maximum per academic year.

Mat E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department: sophomore classification.* Professional work period, one semester maximum per academic year.

Mat E 306. Physical Metallurgy. (4-0) Cr. 4. S. *Prereq: 315.* Solidification from the melt of pure materials and alloy mixtures. Ternary phase equilibria. Cast iron solidification. Second phase nucleation, precipitation and growth. Twinning and martensite transformations. Cast iron and steel heat treatment. Nonmajor graduate credit.

Mat E 306L. Physical Metallurgy Laboratory. (1-6) Cr. 3. S. *Prereq: Credit or enrollment in 306.* Experiments are carried out and analyzed which involve the following topics. Carburizing of steel. Jominy end quench, welding of various steels, and x-ray plus metallographic evaluation of retained austenite. Two design experiments are done involving carburizing and age hardening of aluminum alloys. Materials fee. Nonmajor graduate credit.

Mat E 313. Integrated Materials Design. (1-3) Cr. 2. F. *Prereq: 213.* Design of devices, parts, processes or systems (including experiments) taking into account physical, chemical, mechanical, economic and ethical principles. Project planning, including scheduling and cost estimation. Application of design tools such as CAD, CAM and FEM. Analysis of problems, design and development of solutions. Safety, concept of shared responsibility, teamwork, communication. Testing and data collection. Interpretation of results and reporting. Oral presentation skills.

Mat E 315. Kinetics and Phase Equilibria in Materials. (3-0) Cr. 3. F. *Prereq: 211, 212.* Kinetic phenomena and phase equilibria relevant to the origins and stability of microstructure in metallic, ceramic and polymeric systems. Application of thermodynamics to the understanding of stable and metastable phase equilibria, interfaces and their effects on stability: defects and diffusion, empirical rate equations for transformation kinetics, driving forces and kinetics of nucleation, diffusional and diffusionless phase transformations. Nonmajor graduate credit.

Mat E 316. Computational Methods in Materials. (2-3) Cr. 3. S. *Prereq: 211.* Use of mathematical and statistical computer tools for materials design and analysis. Applications of statistical principles to problems concerned with materials. Computer-assisted design of experiments. Nonmajor graduate credit.

Mat E 318. Mechanical Behavior of Materials. (2-3) Cr. 3. S. *Prereq: E M 324.* Mechanical behavior of ceramics, metals, polymers, and composites. Relationships between materials processing and atomic aspects of elasticity, plasticity, fracture, and fatigue. Life prediction, stress-and failure analysis. Nonmajor graduate credit.

Mat E 321. Ceramic Processing - Forming. (2-3) Cr. 3. F. *Prereq: 211.* Raw materials, characterization of ceramic powders and slurries, ceramic forming methods - slip casting, injection molding, extrusion, dry pressing, drying and evaluation of green microstructures, relationship between powder characteristics and resulting microstructure. Nonmajor graduate credit.

Mat E 322. Ceramic Processing - Firing. (2-3) Cr. 3. S. *Prereq: 211.* High temperature ceramic firing, interpretation of phase diagrams, analysis of silicate systems, liquid and solid-state sintering, grain growth, microstructure development and advanced fabrication methods. Nonmajor graduate credit.

Mat E 331. Introduction to Electronic Properties of Materials. (2-3) Cr. 3. F. *Prereq: 211.* Introduction to

electronic properties of materials and their practical applications. Band theory of electron states in materials, conduction mechanisms, electrical properties, magnetic properties and classification of magnetic materials, optical properties of metallic, semiconducting and dielectric materials. Laboratory experiments. Nonmajor graduate credit.

Mat E 332. Semiconductor Materials and Devices. (Same as E E 332.) (3-0) Cr. 3. S. *Prereq: 331 or E E 333 and credit or enrollment in E E 312 or Phys 222.* Introduction to semiconductor material and device physics. Quantum mechanics and band theory of semiconductors. Charge carrier distributions, generation/recombination, transport properties. Physical and electrical properties and fabrication of semiconductor devices such as MOSFETs, bipolar transistors, laser diodes and LED's. Nonmajor graduate credit.

Mat E 334. Introduction to Magnetic Materials. (3-0) Cr. 3. S. *Prereq: At least one of Mat E 331, Phys 364, E E 312.* Magnetism in materials, electron spins, magnetic order, diamagnetism, paramagnetism and ferromagnetism. Magnetic properties of materials, anisotropy, exchange and magnetic phase transformations. Magnetic domain theory. Effects of magnetic fields on materials. Hard and soft magnetic materials. Materials for magnetic recording applications. Nonmajor graduate credit.

Mat E 341. Metals Processing and Fabrication. (2-3) Cr. 3. F. *Prereq: 211, 214.* Processing of metals. Machining, deformation and texturing effects, joining (welding, brazing, soldering), casting, powder metallurgy. Nonmajor graduate credit.

Mat E 342. Structure/Property Relations in Metals. (2-3) Cr. 3. S. *Prereq: 211, 214, 315.* Processing of metals and alloys to obtain desired mechanical properties by manipulation of their microstructure and composition of constituent phase(s). Relevance of defects to mechanical properties, plastic flow. Strengthening mechanisms in metals and alloys. Microstructure, heat treatment and mechanical properties of engineering alloys. Metal-matrix composites. Nonmajor graduate credit.

Mat E 351. Introduction to Polymeric Materials. (3-0) Cr. 3. *Prereq: 211.* Polymers in everyday life, nature of polymeric materials. Organic chemistry review of step, chain (free radical, anionic and cationic) and ring opening polymerization reactions, kinetics and thermodynamics of polymerization reactions, polymer structural design and control, polymer property prediction, synthesis of polymer networks and crosslinking reactions, copolymerization, recent advances in coordination, block and graft copolymers and dendrimer. Nonmajor graduate credit.

Mat E 352. Physical and Mechanical Properties of Polymers. (2-3) Cr. 3. *Prereq: 351.* Thermal transition/glassy state, crystallization, polymer stability and degradation, solubility, diffusion and permeability, viscoelasticity, Boltzman superposition, rubber elasticity, fracture, mechanical properties of composites, electrical and optical properties. Relationship between polymer structure and its properties. Laboratory experiments for mechanical and physical characterization of polymers. Nonmajor graduate credit.

Mat E 362. Principles of Nondestructive Testing. (Same as E M 362.) (3-0) Cr. 3. S. *Prereq: Phys 112 or 222.* Radiography, ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection, and other less common techniques. Physical bases of tests: materials to which applicable: types of defects detectable: calibration standards, and reliability safety precautions. Nonmajor graduate credit.

Mat E 362L. Nondestructive Testing Laboratory. (Same as E M 362L.) (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 362.* Application of nondestructive testing techniques to the detection and sizing of flaws in materials and to the characterization of material's microstructure. Included are experiments in hardness, dye penetrant, magnetic particle, x-ray, ultrasonic and eddy current testing. Field trips are taken to laboratories practicing state of the art industrial procedures and developing next generation techniques. Field trip fee. Nonmajor graduate credit.

Mat E 370. Toying with Technology. (Same as Cpr E 370.) (2-2) Cr. 3. F.S. *Prereq:* Junior standing in non-engineering major. A project-based, hands-on learning course. Technology literacy, appreciation for technological innovations, principles behind many technological innovations, hands-on laboratory experiences based upon simple systems constructed out of LEGOs and controlled by small microcomputers. Future K-12 teachers will leave the course with complete lesson plans for use in their upcoming careers.

Mat E 396. Summer Internship for International Students. Cr. R. SS. *Prereq:* Permission of department. Summer professional work period for international students.

Mat E 397. Engineering Internship. Cr. R. F.S. *Prereq:* Permission of department; junior classification. Professional work period, one semester maximum per academic year.

Mat E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of department; junior classification. Required of all cooperative students. Students must register for this course prior to commencing each work period.

Mat E 413. Integrated Materials Design. (1-3) Cr. 2. F. *Prereq:* 313. Design of devices, parts, processes or systems (including experiments) taking into account physical, chemical, mechanical, economic and ethical principles. Project planning, including scheduling and cost estimation. Application of design tools such as CAD, CAM and FEM. Analysis of problems, design and development of solutions. Safety, concept of shared responsibility, teamwork, communication. Testing and data collection. Interpretation of results and reporting. Oral presentation skills.

Mat E 414. Materials Engineering Design. (0-6) Cr. 2. S. *Prereq:* Senior classification. Application of economic, physical, chemical, and mechanical principles to industry-specified design of materials and processes. Oral and written reports.

Mat E 423. Glass Science and Engineering. (2-3) Cr. 3. F. *Prereq:* 212. Composition, structure, properties, manufacturing, and uses of inorganic glasses, especially silicate glasses. Nonmajor graduate credit.

Mat E 424. Ceramic Industries. (3-0) Cr. 3. S. *Prereq:* 322. Property control of products for various ceramic industries. Utilization of ceramic products in contemporary applications with a global perspective for raw materials, engineering science and industrial activity. Ethical, economic, and life-long learning aspects for professional engineering practice. Nonmajor graduate credit.

Mat E 433. Dielectric Materials. (3-0) Cr. 3. F. *Prereq:* 331. Introduction to dielectric materials their properties and applications in capacitors, piezoelectrics and other passive devices. Theory of dielectrics, polarization, ferroelectrics. Materials for electro-optic applications. Thin and thick films, devices and bulk dielectric materials. Nonmajor graduate credit.

Mat E 431. Introduction to Microelectronics Fabrication. (Same as E E 431.) (2-4) Cr. 4. Semester: varies. *Prereq:* E E 332 or Mat E 332. An introduction to microelectronic device fabrication with hands-on laboratory experience. Students design, fabricate and evaluate basic semiconductor materials and devices. Electronic materials processing techniques, deposition and growth, etching and photolithography, are emphasized. Materials concerns such as electron migration, contacting, film stress, barrier properties and dielectric quality are also covered. Materials fee. Nonmajor graduate credit.

Mat E 443. Ferrous Metallurgy. (2-3) Cr. 3. S. *Prereq:* 211, 214. Production and processing of ferrous metals. Extraction of pig iron from ore. Steelmaking processes. Equilibrium and nonequilibrium phases in the Fe-C system. Properties and processing of cast irons, plain carbon and alloy steels, stainless and specialty steels. Transformation diagrams, hardenability, and surface treatments. Continuous casting, forging, hot rolling, quenching, and tempering as they apply to ferrous materials. Cost and mechanical performance considerations in

cast iron and steel selection and heat treatment. Nonmajor graduate credit.

Mat E 444. Corrosion and Failure Analysis. (2-3) Cr. 3. *Prereq:* 211, 318. Corrosion and corrosion control of metallic systems. Corrosion fundamentals, classification of different types of metallic corrosion, corrosion properties of various engineering alloys, corrosion control. Failure analysis. Characteristics of common types of metallic failures, case studies of failures (e.g. fatigue, creep, etc.), designing to reduce failure risk, failure in composite systems. Nonmajor graduate credit.

Mat E 453. Introduction to Polymer and Composite Processing. (3-0) Cr. 3. *Prereq:* 352. The molten state of polymers: non-Newtonian viscosity. Introduction to principles of processing of thermoplastics, thermosets, and rubbers. Review of polymer melt processing methods such as injection molding and extrusion; selection of suitable processing methods and their applications. Basic concepts and characterization of mixing. Nonmajor graduate credit.

Mat E 454. Industrial Polymers and Processing. (2-3) Cr. 3. *Prereq:* 351. Industrial polymerization reactions, fabrication of polymeric materials. Adhesives, coatings, and textiles. Recycling of polymers, economics considerations. Hands on experience in operation of processing instruments. Data analysis and interpretation is an integral part of the course. Nonmajor graduate credit.

Mat E 466. Multidisciplinary Engineering Design. (Same as A E 466, Cpr E 466, E E 466, E Sci 466, I E 466, M E 466.) (1-4) Cr. 3. F.S. *Prereq:* Student must be within two semesters of graduation and receive permission of the instructor. Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM, and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

Mat E 490. Independent Study. Cr. arr. Investigation of individual research or special topics.
A. Metallic Materials
B. Ceramic Materials
C. Electronic Materials
D. Polymeric Materials
H. Honors

Mat E 497. Engineering Internship. Cr. R. F.S. *Prereq:* Permission of department; senior classification. Professional work period, one semester maximum per academic year.

Mat E 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of department; senior classification. Required of all cooperative students. Students must register for this course prior to commencing each work period.

Materials Science and Engineering

Mufit Akinc, Chair of Department

Distinguished Professors: Gschneidner, Thompson, Trivedi, Verhoeven

Professors: Akinc, Jiles, D. Martin, S. Martin, McGee

Professors (Adjunct): Anderson, McCallum

Professors (Emeritus): Larsen, Patterson, Smith, Wechsler, Wilder

Associate Professors: Chumbley, K. Constant, Genalo, Pecharsky, Schilling

Associate Professors (Adjunct): Biner, Kramer, Lograsso

Assistant Professors: Cann, A. Constant, Gleeson, Otaigbe, Russell

Assistant Professors (Adjunct): Selby, Sordelet

Graduate Study

The department offers work for the degrees master of science (with thesis) and doctor of philosophy, with a major in Materials Science and Engineering. Research in the department is administered through the Ames Laboratory, IPRT centers, and the Engineering Research Institute, which provide support for graduate student research assistantships.

Graduates have a broad understanding of materials science and engineering and related disciplines. They are able to communicate effectively with scientific colleagues in formal and informal settings. Graduates are able to address complex problems in materials science and process design while considering the various constraints inherent to both industrial and research environments. They are skilled in carrying out independent and collaborative research, communicating research results and writing concise and persuasive grant proposals.

Prerequisite to major graduate work is completion of an undergraduate curriculum in physical science or related engineering. However, well qualified juniors in metallurgical or ceramic engineering interested in graduate study can apply for concurrent enrollment in the Graduate College to simultaneously pursue M.S. and B.S. degrees. Graduate assistantships can be awarded to students concurrently enrolled. Both M.S. and B.S. degrees can be obtained in five years of study under the concurrent enrollment plan.

There are no foreign language requirements for either of the graduate degrees administered by the Department of Materials Science and Engineering.

Graduate students wishing to declare a formal minor in Materials Science and Engineering will have at least one M S E faculty member serving on their advisory committee. For the M.S. and Ph.D. degrees, they will take a minimum of 8 and 12 M S E course credits, respectively (at least 2 and 8 credits, respectively, at the 500 and 600 level).

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

M S E 501. Thermodynamics of Materials. (3-0) Cr. 3. F. *Prereq:* Mat E 315 or Mat E 212 or Chem 321, Math 266. Review of basic principles, thermodynamics of multiphase chemical reactions, thermodynamic potentials, stability principles, solution thermodynamics, free-energy-composition diagrams, multicomponent phase diagrams, and thermodynamic driving forces. Nucleation and spinodal decomposition theory.

M S E 502. Kinetics of Processes in Materials Science. (3-0) Cr. 3. S. *Prereq:* 501. Reaction kinetics. Atomic and phenomenological theories of diffusion. Defects in solids. Phase transformation kinetics. Micro-structure development.

M S E 516. Chemistry of Crystalline Materials. (3-0) Cr. 3. *Prereq:* Mat E 211. Review of the fundamentals of bonding in solids. Crystal and ligand field theories. Crystal systems and symmetry operations.

Crystal chemistry of metals and inorganic compounds. Crystal structure-property relationships.

M S E 517. Physical Metallurgy of Alloys. (3-0) Cr. 3. Alt. F. *Prereq: Mat E 306.* Application of fundamental concepts of phase transformations, heat flow, mechanical behavior, and structure-property relations to the problems of heat treatment and selection of steels and aluminum, copper, and titanium alloys.

M S E 518. Metallurgy of Rare Earths. (2-0) Cr. 2. Alt. F. *Prereq: Mat E 306 or Phys 322 or 324 or Chem 321.* Electronic configuration, valence states, minerals, ores, beneficiation, extraction, separation, metal preparation and purification, crystal structure, transformation, melting and boiling points, chemical behavior, inorganic compounds, alloy chemistry, nature of the chemical bond, mechanical and elastic properties, magnetic properties, resistivity, and superconductivity.

M S E 519. Magnetism and Magnetic Materials. (Same as E E 519.) (3-0) Cr. 3. *Prereq: 271 or Mat E 211 or 271 or 272 or Mat E 211 or E E 313 or Phys 364.* Magnetic fields, flux density and magnetization. Magnetic materials, magnetic measurements. Magnetic properties of materials. Domains, domain walls, domain processes, magnetization curves and hysteresis. Types of magnetic order, magnetic phases and critical phenomena. Magnetic moments of electrons, theory of electron magnetism. Technological application, soft magnetic materials for electromagnets, hard magnetic materials, permanent magnets, magnetic recording technology, magnetic measurements of properties for materials evaluation.

M S E 521. Mechanical Behavior and Manufacturing of Polymers and Composites. (Same as M E 521.) See *Mechanical Engineering.*

M S E 528. Structure and Properties of Glass. (3-0) Cr. 3. Alt. S. *Prereq: 347 or Mat E 423 or 360 or Mat E 212 or Chem 321.* Advanced theory of the vitreous state. Structure of glasses, nucleation theory, control of devitrification, composition-structure property relationships.

M S E 533. Characterization Methods in Materials Science. (2-3) Cr. 3. F. *Prereq: 315 or Mat E 214 or equivalent.* Characterization of ceramic, metal, polymer and glassy materials using modern analytical techniques. Spectroscopic (IR, Raman, UV/VIS/NIR, and NMR), thermal (DSC, DTA/TGA, and DMA) methods, mechanical and rheological testing, magnetic and electrical characterization, and powder characterization.

M S E 534. Scanning and Auger Electron Microscopy. (2-3) Cr. 3. F. *Prereq: Phys 221.* Characterization of materials using scanning electron microscope (SEM), electron microprobe, and auger spectrometer. Compositional determination using energy and wavelength dispersive x-ray and Auger spectroscopies. Specimen preparation. Laboratory covers SEM operation.

M S E 535. X-Ray, Electron and Neutron Diffraction. (3-0) Cr. 3. S. *Prereq: 315 or Mat E 214.* Introduction to theory of X-ray, electron and neutron diffraction, symmetry operations, space groups, and reciprocal lattice. Laue and powder diffraction methods and their application to precise lattice parameters, determination of simple crystal structures, phase identification, orientation, texture, grain size, strain, residual stress, and order-disorder.

M S E 539. Electronic Properties of Materials. (Same as E E 539.) (3-0) Cr. 3. *Prereq: 343 or Mat E 331 or E E 332 or Phys 322.* Continuum model of materials, definition of physical properties. Electron theory, free electron model of conduction electrons, quantum corrections, internal potential and bound electrons. Electronic properties of metals, Brillouin zones, Fermi surface. Semiconductors, conduction and valence bands. Electrical, thermal, optical and magnetic properties of materials. Technological applications, microelectronics and semiconductors, optoelectronics, superconductivity, magnetic recording technology. Electronic materials for transducers.

M S E 541. Mechanical Behavior of Materials. (3-0) Cr. 3. F. *Prereq: 305 or Mat E 315, Math 266.* Mechanical behavior of materials based on atomic

and microstructural considerations. Elasticity, plasticity, yield criteria, introduction to dislocation theory. Brittle and ductile fracture, fatigue and creep, design criteria, statistical aspects of failure.

M S E 544. Oxidation and Corrosion. (3-0) Cr. 3. Alt. S. *Prereq: Mat E 214.* Study of origin, development, and current applicability of theories of corrosion and oxidation of materials.

M S E 550. Fundamentals of Nondestructive Evaluation. (Same as E M 550.) See *Engineering Mechanics.*

M S E 561. Materials Processing Design. (3-0) Cr. 3. Alt. S. Statistical design of experiments. Data acquisition and control. Machine design fundamentals: Autocad. Practical aspects of heat and mass transfer. Process modeling.

M S E 563. Powder Processing of Materials. (3-0) Cr. 3. F. *Prereq: Mat E 214.* Introduction to materials processing science. Powder processing routes, characterization of powders. Fabrication of materials by casting, molding, pressing, rolling and forging operations. Densification by solid or liquid phase sintering, hot pressing, and hot isostatic pressing. Microstructure development.

M S E 564. Fracture and Fatigue. (Same as E M 564.) See *Engineering Mechanics.*

M S E 566. Deformation Processing. (3-0) Cr. 3. Alt. S. *Prereq: 306 or 307 or Mat E 315.* Theory and applications of deformation processes as applied to fabrication of metals, glasses and polymers. Shape forming by viscous and/or plastic deformation. Examples of common processing methods including: extrusion, injection molding, compression molding, forging, casting.

M S E 568. Plasticity and Creep of Materials. (Same as E M 568.) See *Engineering Mechanics.*

M S E 569. Mechanics of Composite and Combined Materials. (Same as E M 569.) See *Engineering Mechanics.*

M S E 574. Ultrasonic Nondestructive Measurement Principles. (Same as E M 574.) See *Engineering Mechanics.*

M S E 580. Biomaterials. (Same as E M 580.) See *Engineering Mechanics.*

M S E 590. Special Topics. Cr. var. *Prereq: Permission of instructor.*

- A. Metallurgy
- B. Ceramics
- C. Polymers
- D. Electronic Materials

M S E 599. Creative Component. Cr. var.

Courses for Graduate Students

M S E 603. Mathematical Methods for Materials Research. (3-0) Cr. 3. Alt. F. *Prereq: Math 266 and permission of instructor.* Development of mathematical tools for problem solving and modeling in materials science and engineering, including crystallography, wave propagation, phase transformations, heat and mass transfer, diffraction and anisotropic properties.

M S E 612. Alloy Theory. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: 516 or Phys 324 or Chem 402.* Substitutional solid solution alloys—models of Friedel, Hume-Rothery, Brewer-Engel; interstitial solid solution alloys; compound formation—Miedema's model, crystal chemistry approaches, and metastable alloys.

M S E 635. Transmission Electron Microscopy. (3-3) Cr. 4. S. *Prereq: 534.* Characterization of inorganic materials using TEM. Selected area and convergent beam electron diffraction, bright field/dark field/high resolution imaging. Compositional analysis using x-ray and electron energy loss spectroscopy.

M S E 642. Mechanical Performance of Materials. (3-0) Cr. 3. Alt. S. *Prereq: 541.* Effects of microstructural and macroscopic defects on mechanical properties of materials. Dynamic and temperature effects. Crack initiation and propagation. Creep, hydrogen and radiation embrittlement, stress corrosion cracking, wear. Characterization by nondestructive evalua-

tion, remaining life prediction and life extension methods. Student presentations.

M S E 646. Defects in Crystalline Materials. (2-0) Cr. 2. Alt. S. *Prereq: 307 or Mat E 322, 516.* Properties of crystals containing point defects such as Frenkel and Schottky defects plus defects created by non-stoichiometry and doping. Defect concentration-property relations.

M S E 661. Advanced Powder Processing. (3-0) Cr. 3. *Prereq: 563.* Current issues in powder processing of metals and ceramics. Emergent methods in powder synthesis, forming and densification. Theoretical and experimental advances in powder processing research.

M S E 662. Advanced Solidification Processing. (3-0) Cr. 3. *Prereq: 305 or Mat E 315.* Dendritic growth and control of macrostructure in castings, ingots, and continuous cast metals. Porosity and its control. Riser and gating design. Mechanical properties of cast metals.

M S E 663. Advanced Deformation Processing. (2-0) Cr. 2. *Prereq: 521 or 528 or 566.* Current issues in deformation processing of glasses and polymers. Emergent methods in deformation processes. Survey of contemporary industrial processes resulting in products/devices. Advances in processing research.

M S E 690. Advanced Topics in Materials Science. Cr. var. *Prereq: Permission of instructor.*

M S E 699. Research.

Mathematics

Max D. Gunzburger, Chair of Department

Distinguished Professors: Athreya

University Professors: Cornette

Professors: Cain, Colwell, Dahiya, Dickson, Evans, Fink, Gautesen, Gunzburger, Hentzel, Johnston, Kliemann, Levine, Lieberman, Luecke, Maddux, Murdock, Peters, Peterson, Pigozzi, Rothmayer, Rudolph, Sacks, Smiley, Smith, Tesfatsion, Tondra, Willson, Wright

Distinguished Professors (Emeritus): Miller, Vinograd

Professors (Emeritus): Abian, Barnes, Carlson, Homer, Mathews, Peglar, Sanderson, Seifert, A. Steiner, E. Steiner, Weiss

Associate Professors: Alexander, Ashlock, Bergman, Canic, Davidson, Du, Gregorac, Hansen, Heimes, Hogben, Hou, Keinert, Poon, Smith, Song, Wagner, Weerasinghe, Wilson

Associate Professors (Adjunct): Gustafson

Assistant Professors: Keller, Mirkovic, Peake, Seppalainen, Sethuraman, Tidiri, Wang

Assistant Professors (Adjunct): Mather

Undergraduate Study

For the undergraduate curriculum in liberal arts and sciences, major in mathematics, leading to the degree bachelor of science, see *Liberal Arts and Sciences, Curriculum.*

The program in mathematics offers training suitable for students planning to enter secondary school teaching, to work in mathematics and computation for industry or government, or to continue their studies in graduate school. The requirements for an undergraduate major in mathematics are designed so that the student may have opportunity for appropriate specialization to meet one or more of the

foregoing objectives and, at the same time, obtain a thorough introduction to the mathematics underlying all of them.

Graduates understand a broad range of mathematical topics and are familiar with a broad range of mathematical models. They have skills for solving problems in diverse situations. They can construct rigorous arguments to demonstrate mathematical facts. They can communicate their mathematical methods to others and can justify their assumptions.

The requirements for an undergraduate major include:

(a) 165, 166, 265, 301, 317, 414, and either 266 or 267.

(b) 15 additional credits chosen from math courses at the 300 level or above, 6 of which must be included in (341, 365, 471, 481).

(c) The courses used to satisfy a) and b) above must include one of the sequences 301, 302; 414, 415; 435, 436.

(d) At least two of 165T, 166T, 265T.

(e) At least one of 490, 491, 492, or 542.

(f) English proficiency requirement: The department requires a grade of C– or better in each of English 104 and 105 (or 105H) and an upper-level writing requirement that may be met by writing an acceptable undergraduate thesis (Math 491) or by taking at least one of Engl 302, 305, 314 or JI MC 201. A grade of C– or better is required.

The department strongly recommends that each student majoring in mathematics include in the program substantial supporting work beyond the minimum general education requirement of the college in one or more areas of application of mathematics, such as other mathematical sciences, engineering, natural science, or social science. In particular, it recommends that each student take Com S 207, 208; Phys 221, 222; and Stat 341, 342 (or Math 304). It also strongly recommends two years of French, German, or Russian for students contemplating graduate study in mathematics. Credits earned in Math 104, 105, 140, 141, 142, 150, 151, 160, 181, 182, 195, 196, 297, cannot be counted toward graduation by mathematics majors.

The department offers a minor in mathematics which may be earned by credit in Math 165, 166, 265, 301, 307 or 317, and 266 or 267. Courses below 165 cannot be used.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in mathematics or applied mathematics, and minor work to students taking major work in another department. The department also offers work for the degree of masters of school mathematics (M.S.M.).

Students desiring to undertake graduate work leading to the M.S. or Ph.D. degree should have at least 12 semester credits of work in mathematics beyond calculus. It is desirable that these credits include advanced calculus and abstract algebra.

The M.S. degree requires at least 30 credit hours and students must write a creative component or thesis and pass a comprehensive oral examination over their coursework and their creative component or thesis. See the department handbook for specific requirements.

The Ph.D. degree requires a student to take 54 hours of coursework in addition to research hours, pass written qualifying examinations, pass an oral preliminary exam, and perform an original research project culminating in a dissertation which is defended by an oral exam. Ph.D. candidates must have at least one year of supervised teaching experience. See the department handbook for specific requirements. (Also see the website: www.math.ias.tate.edu/gradcomm/gradreq.html for details.)

The M.S.M. degree is primarily for inservice secondary mathematics teachers. Students desiring to pursue the M.S.M degree should present some undergraduate work in mathematics beyond calculus. Candidates for the M.S.M. degree must write an approved creative component and pass a comprehensive oral examination over their course work and their creative component.

Courses open for nonmajor graduate credit: 301, 302, 304, 307, 308, 314, 317, 331, 365, 378, 385, 395, 414, 415, 421, 426, 435, 436, 439, 450, 465, 471, 481, 489.

Courses Primarily for Undergraduate Students

Math 10. High School Algebra. (4-0) Cr. 0. F.S.SS. For students who do not have adequate facility with topics from high school algebra or do not meet the algebra admission requirement. All students should initially enroll in Math 10. The course is divided into tracks of one- and two-semester lengths. For most students a diagnostic exam will determine which track must be taken, while those not meeting the algebra admission requirement must take a two-semester track. Students will receive a grade in Math 25 or 30 respectively depending on the level of material covered. Satisfactory completion of Math 30 is recommended for students planning to take Math 140 or 151, while Math 25 is sufficient for Math 104, 105, 150, 195, Stat 101 or 105. Students must complete Math 30 to remove a deficiency. Topics include signed numbers, polynomials, rational and radical expressions, exponential and logarithmic expressions, and equations. Offered on a satisfactory-fail grading basis only. Developmental math fee.

Math 20. High School Geometry. (4-0) Cr. 0. S. For students who do not meet the geometry admission requirement. Elements of Euclidean geometry including congruence, parallel lines, circles, similar polygons, perimeters, areas, surface areas, and volumes. Offered on a satisfactory-fail grading basis only. Developmental math fee.

Math 25. High School Algebra. (4-0) Cr. 0. F.S.SS. For students who do not have adequate facility with topics from high school algebra or do not meet the algebra admission requirement. All students should initially enroll in Math 10. The course is divided into tracks of one- and two-semester lengths. For most students a diagnostic exam will determine which track must be taken, while those not meeting the algebra admission requirement must take a two-semester track. Students will receive a grade in Math 25 or 30 respectively depending on the level of material covered. Satisfactory completion of Math 30 is recommended for students planning to take Math 140 or 151, while Math 25 is sufficient for Math 104, 105, 150, 195, Stat 101 or 105. Students must complete Math 30 to remove a deficiency. Topics include signed numbers, polynomials, rational and radical expressions, exponential and logarithmic expres-

sions, and equations. Offered on a satisfactory-fail grading basis only. Developmental math fee.

Math 30. High School Algebra. (4-0) Cr. 0. F.S.SS. For students who do not have adequate facility with topics from high school algebra or do not meet the algebra admission requirement. All students should initially enroll in Math 10. The course is divided into tracks of one- and two-semester lengths. For most students a diagnostic exam will determine which track must be taken, while those not meeting the algebra admission requirement must take a two-semester track. Students will receive a grade in Math 25 or 30 respectively depending on the level of material covered. Satisfactory completion of Math 30 is recommended for students planning to take Math 140 or 151, while Math 25 is sufficient for Math 104, 105, 150, 195, Stat 101 or 105. Students must complete Math 30 to remove a deficiency. Topics include signed numbers, polynomials, rational and radical expressions, exponential and logarithmic expressions, and equations. Offered on a satisfactory-fail grading basis only. Developmental math fee.

Math 100. Orientation in Mathematics. (1-0) Cr. R. F. For new majors. Issues to consider in planning a program of study. Sources of general information and perspectives concerning mathematics. Discussion of possible areas of study or careers. Offered on a satisfactory-fail grading basis only.

Math 104. Introduction to Probability and Matrices. (3-0). Cr. 3. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry.* Permutations, combinations, probability, binomial and multinomial theorems, matrices, Markov chains, expected value. Either 104 or 150 may be counted toward graduation, but not both.

Math 105. Introduction to Mathematical Ideas. (3-0) Cr. 3. F.S. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry.* Topics from mathematics and mathematical applications with emphasis on their nontechnical content.

Math 140. College Algebra. (3-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra; 1 year of high school geometry.* Coordinate geometry, complex numbers, quadratic and polynomial equations, functions, graphing, systems of equations, exponential and logarithmic functions, determinants. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, 149, or 195 toward Group III of the General Education Requirements.

Math 141. Trigonometry. (2-0) Cr. 2. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra; 1 year of high school geometry, or enrollment in 140. May be taken concurrently with 140.* Trigonometric functions and their inverses, solving triangles, trigonometric equations, polar coordinates, graphing. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, 149, or 195 toward Group III of the General Education Requirements. Only one of 141, 142 may count toward graduation.

Math 142. Trigonometry and Analytic Geometry. (2-1) Cr. 3. F.S.SS. *Prereq: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry, or enrollment in 140. May be taken concurrently with 140.* Trigonometric functions and their inverses, solving triangles, trigonometric equations, polar coordinates, standard equations of lines and conic sections, conics in polar form, graphing of rational functions, quadric surfaces. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, 149, or 195 toward Group III of the General Education Requirements. Only one of 141, 142 may count toward graduation.

Math 149. Precalculus Mathematics. (5-0) Cr. 4. F. *Prereq: Satisfactory performance on placement exams; 2 years high school algebra; 1 year geometry; 1 semester of trigonometry.* A fast-paced review of topics from algebra, trigonometry, and analytic geometry required for the Math 165, 166, 265 calculus sequence. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142,

149, or 195 toward Group III of the General Education Requirements. Only one of 140, 149 may count toward graduation.

Math 150. Discrete Mathematics for Business and Social Sciences. (2-1) Cr. 3. F.S.SS. *Prereq:* *Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry.* Linear equations and inequalities, linear programming, matrix algebra, discrete probability. Either 104 or 150 may be counted toward graduation, but not both.

Math 151. Calculus for Business and Social Sciences. (2-1) Cr. 3. F.S.SS. *Prereq:* *Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry.* Differential calculus, integral calculus, introduction to max-min theory for functions of two variables. Will not serve as prerequisite for 265 or 266. Only one of 151, 160, the sequence 165-166, or 181 may be counted toward graduation.

Math 160. Survey of Calculus. (4-0) Cr. 4. F.S. *Prereq:* *Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry or enrollment in 141 or 142.* Analytic geometry, differentiation and integration of elementary functions. Will not serve as a prerequisite for 265 or 266. Only one of 151, 160, the sequence 165-166, or 181 may be counted toward graduation.

Math 165. Calculus I. (4-0) Cr. 4. F.S.SS. *Prereq:* *Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry or enrollment in 141 or 142.* Functions, limits, continuity, differentiation, derivatives of vector-valued functions, applications of derivatives. Only one of 151 or 160 or the sequence 165-166, or 181 may be counted toward graduation.

Math 165H. Honors Calculus I. (4-0) Cr. 4. F.S. *Prereq:* *Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry. High math placement scores recommended but not required.* Functions, limits, continuity, differentiation, derivatives of vector-valued functions, applications of derivatives. Additional material of a theoretical, conceptual, computational, or modeling nature. Some of the work may require more ingenuity than is required in Math 165. Preference will be given to students in the University Honors Program. Only one of 151 or 160 or 181 or the sequence 165-166 may be counted toward graduation.

Math 165T. Theory of Calculus I. (1-0) Cr. 1. F.S. *Prereq:* *165 or enrollment in 165.* Consideration of some of the basic theoretical concepts associated with a first course in calculus. Emphasis on student presentation of the material studied.

Math 166. Calculus II. (4-0) Cr. 4. F.S.SS. *Prereq:* *Grade of C- or better in 165 or 165H or high math placement scores.* Integration, applications of the integral, matrices, differentiation of functions of several variables. Only one of 151, 160, the sequence 165-166, or 181 may be counted toward graduation.

Math 166H. Honors Calculus II. (4-0) Cr. 4. F.S. *Prereq:* *Permission of instructor and 165, 165H, or high math placement scores.* Integration, applications of the integral, matrices, differentiation of functions of several variables. Additional material of a theoretical, conceptual, computational, or modeling nature. Some of the work may require more ingenuity than is required for Math 166. Preference will be given to students in the University Honors Program. Only one of 151, or 160, or 181 or the sequence 165-166 may count toward graduation.

Math 166T. Theory of Calculus II. (1-0) Cr. 1. F.S. *Prereq:* *166 or enrollment in 166.* Consideration of some of the basic theoretical concepts associated with a second course in calculus. Emphasis on student presentation of the material studied.

Math 181. Calculus and Differential Equations for the Life Sciences. (3-2) Cr. 4. F.S. *Prereq:* *Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry, 1 semester of trigonometry or enrollment*

in 141 or 142. Exponential and logarithm functions, derivative, integral, difference equations and differential equations. Examples taken from laboratory experiments. Materials fee. Only one of 151, 160, the sequence 165-166, or 181 may be counted toward graduation.

Math 182. Calculus and Differential Equations for the Life Sciences. (3-2) Cr. 4. F.S. *Prereq:* *181.* Exponential and logarithm functions, derivative, integral, difference equations and differential equations. Examples taken from laboratory experiments. Materials fee. Only one of 151, 160, the sequence 165-166, or 181 may be counted toward graduation.

Math 195. Mathematics for Elementary Education I. (2-2) Cr. 3. F.S. *Prereq:* *Satisfactory performance on placement exam, 2 years high school algebra, 1 year of high school geometry, enrollment in programs elementary education or child development.* Language of sets, systems of whole numbers, numeration and algorithms for computation, topics from number theory, geometric shapes and measurement, congruence, similarity and transformations, probability and statistics.

Math 196. Mathematics for Elementary Education II. (2-2) Cr. 3. F.S. *Prereq:* *Grade of C- or better in 195.* Language of sets, systems of whole numbers, numeration and algorithms for computation, topics from number theory, geometric shapes and measurement, congruence, similarity and transformations, probability and statistics.

Math 205. Computer Programming in FORTRAN. (Same as Com S 205.) See *Computer Science.*

Math 215. Numerical Methods and FORTRAN Programming. (Same as Aer E 215.) See *Aerospace Engineering.*

Math 252. Topics in Optimization. (3-0) Cr. 3. F. *Prereq:* *104 or 150, and one of 151, 160, 165.* Partial and total derivatives, optimization problems including the Lagrange multiplier rule, the Kuhn-Tucker conditions, second order conditions, post-optimal analysis.

Math 265. Calculus III. (4-0) Cr. 4. F.S.SS. *Prereq:* *Grade of C- or better in 166 or 166H.* Multiple integrals, vector fields and vector integrals, sequences and series.

Math 265H. Honors Calculus III. (4-0) Cr. 4. F.S. *Prereq:* *Permission of the instructor; and 166 or 166H.* Multiple integrals, vector fields and vector integrals, sequences and series. Additional material of a theoretical, conceptual, computational, or modeling nature. Some of the work may require more ingenuity than is required in Math 265. Preference will be given to students in the University Honors Program.

Math 265T. Theory of Calculus III. (1-0) Cr. 1. F.S. *Prereq:* *265 or enrollment in 265.* Consideration of some of the basic theoretical concepts associated with a third course in calculus. Emphasis on student presentation of the material studied.

Math 266. Elementary Differential Equations. (3-0) Cr. 3. F.S.SS. *Prereq:* *Grade of C- or better in 166.* Elementary theory and applications of ordinary differential equations, matrices and solutions of linear equations, eigenvalue methods for systems of linear differential equations.

Math 267. Elementary Differential Equations and Laplace Transforms. (4-0) Cr. 4. F.S.SS. *Prereq:* *Grade of C- or better in 166.* Same as 266 but also including Laplace transforms and series solutions to ordinary differential equations.

Math 268. Laplace Transforms. (1-0) Cr. 1. F. *Prereq:* *266.* Laplace transforms and series solutions to ordinary differential equations. Together, 266 and 268 are the same as 267.

Math 273. Introduction to Scientific Computation. (3-0) Cr. 3. F.S.SS. *Math 265 or enrollment in Math 265; Math 266 or Math 267; knowledge of Fortran or C.* Vector, matrix and graphics programming for scientific applications. Algorithms for interpolation, systems of linear equations, least squares, nonlinear equations and optimization in one and several variables, and ordinary differential equations. Emphasis on high quality mathematical software, its strengths and limitations.

Math 290. Special Problems. Cr. 1 to 3 each time taken.

H. Honors

Math 297. Intermediate Topics in Elementary Mathematics. (2-2) Cr. 3. F.S. *Prereq:* *Grade of C- or better in 196.* Additional topics in geometry including coordinates, congruence similarity, and transformations. Pre-algebraic reasoning. Topics in mathematics of current importance to prospective elementary teachers.

Math 298. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Math 301. Introduction to Abstract Algebra. (3-0) Cr. 3. F.S. *Prereq:* *166 and 307 or 317.* Introduction to the theory of groups and rings. Nonmajor graduate credit.

Math 302. Introduction to Abstract Algebra. (3-0) Cr. 3. S. *Prereq:* *301.* Theory of fields, abstract vector spaces, and linear algebra. Nonmajor graduate credit.

Math 304. Introductory Combinatorics. (3-0) Cr. 3. F. *Prereq:* *166.* Permutations, combinations, binomial coefficients, inclusion-exclusion principle, discrete probability, classical probability. Additional topics selected from recurrence relations, generating functions, random walks, and Markov chains. Nonmajor graduate credit.

Math 307. Theory of Matrices. (3-0) Cr. 3. F.S.SS. *Prereq:* *2 semesters of calculus.* The algebra of matrices including vector spaces, simultaneous linear equations, determinants, quadratic forms, eigenvalues, and diagonalization over the real and complex numbers. Only one of 307, 317 may be counted toward graduation. Nonmajor graduate credit.

Math 308. Application of Linear Algebra to Discrete Optimization. (3-0) Cr. 3. S. *Prereq:* *307 or 317.* Linear programming and topics chosen from game theory, transportation and assignment problems, discrete dynamic processes, and multiple objective linear programming. Nonmajor graduate credit.

Math 314. Graphs and Networks. (3-0) Cr. 3. S. *Prereq:* *166.* Graphs, directed graphs, and trees. Connectedness. Graph colorings. Eulerian and Hamiltonian chains. Matching and covering. Optimization for networks. Applications. Nonmajor graduate credit.

Math 317. Theory of Linear Algebra. (4-0) Cr. 4. F.S. *Prereq:* *166.* Systems of linear equations, determinants, vector spaces, inner product spaces, linear transformations, eigenvalues and eigenvectors. Emphasis on writing proofs and results. Nonmajor graduate credit. Only one of 307, 317 may be counted toward graduation.

Math 331. Topology. (3-0) Cr. 3. S. *Prereq:* *307 or 317.* Topological properties of metric spaces with emphasis on \mathbb{R}^n ; sequences, continuous functions, completeness, compactness. Nonmajor graduate credit.

Math 341. Introduction to Theory of Probability and Statistics. (Same as Stat 341.) See *Statistics.*

Math 342. Introduction to Theory of Probability and Statistics. (Same as Stat 342.) See *Statistics.*

Math 365. Complex Variables with Applications. (3-0) Cr. 3. F.S. *Prereq:* *265.* Functions of a complex variable, including differentiation, integration and series expansions, residues, evaluation of integrals, conformal mapping. Only two of 365, 385, 395 may be counted toward graduation. Nonmajor graduate credit.

Math 378. Optimization and Modeling with Artificial Life. (3-0) Cr. 3. S. *Prereq:* *One of 301, 304, Com S 330 or other discrete math. Familiarity with programming.* Introduction to the modeling and optimization techniques that together are called artificial life or alife. Biological paradigms such as evolution and ecology are used to solve problems in biology and areas such as combinatorial or functional optimization. Evolutionary programming, genetic algo-

rithms, genetic programming, evolutionary neural nets, and their uses in optimization and modeling. Nonmajor graduate credit.

Math 385. Introduction to Partial Differential Equations. (3-0) Cr. 3. F.S. *Prereq:* 265 and one of 266, 267. Fourier series, separation of variable methods, Bessel series and Legendre polynomials, introduction to Sturm-Liouville theory. Only two of 365, 385, 395 may be counted toward graduation. Nonmajor graduate credit.

Math 395. Intermediate Engineering Mathematics. (4-0) Cr. 4. F.S. *Prereq:* 265 and 267. Complex variables and analytic functions, complex integration techniques, complex series, Fourier series, separation of variables in partial differential equations, Fourier transforms. Only two of 365, 385, 395 may be counted toward graduation. Nonmajor graduate credit.

Math 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of the department cooperative education coordinator; junior classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Math 414. Advanced Calculus. (3-0) Cr. 3. F.S.SS. *Prereq:* 265, and 307 or 317. A careful development of calculus of functions of a real variable: limits, continuity, differentiation, integration, series. Nonmajor graduate credit.

Math 415. Advanced Calculus. (3-0) Cr. 3. S. *Prereq:* 414. Sequences and series of functions of a real variable, uniform convergence, power series and Taylor series, Stone-Weierstrass Theorem, elementary functions, Fourier series, introduction to measure theory and Lebesgue integration. Other topics at the discretion of the instructor. Nonmajor graduate credit.

Math 421. Mathematical Logic. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 301 or 307 or 317. Validity, consistency, provability, completeness, definability, and decision problems for propositional calculus, predicate calculus, and generalized mathematical theories. Nonmajor graduate credit.

Math 426. Mathematical Methods for the Physical Sciences. (3-0) Cr. 3. F. *Prereq:* 385. Primarily for first-year graduate students in physics and chemistry. (Not a substitute for Math 526-527.) Emphasis on techniques needed for quantum mechanics and electrodynamics. Fourier integrals, complex variables and contour integration, ordinary differential equations of hypergeometric type, Green's functions, Sturm-Liouville problems and orthogonal functions, boundary-value problems for partial differential equations. Nonmajor graduate credit.

Math 435. Geometry. (3-0) Cr. 3. Yr. *Prereq:* 307 or 317. Euclidean geometry through properties invariant under similarity transformations, projective geometry by use of synthetic and analytic methods, topics chosen from finite geometry, non-Euclidean geometry and crystallography. Nonmajor graduate credit.

Math 436. Geometry. (3-0) Cr. 3. Yr. *Prereq:* 435. Euclidean geometry through properties invariant under similarity transformations, projective geometry by use of synthetic and analytic methods, topics chosen from finite geometry, non-Euclidean geometry and crystallography. Nonmajor graduate credit.

Math 439. Mathematics of Fractals. (3-0) Cr. 3. S. *Prereq:* 265; some knowledge of programming. Topology of metric spaces; iterated function systems; algorithms for generation of fractals; fractal dimension; Julia sets and the Mandelbrot set; applications to chaotic systems. Nonmajor graduate credit.

Math 450. Number Theory. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 301. Properties of the integers. Diophantine equations, prime number distribution and representation problems. Nonmajor graduate credit.

Math 465. Advanced Calculus for Applied Mathematics. (4-0) Cr. 4. F.SS. *Prereq:* 265. Frequently applied concepts from multivariable calculus, presented with enough theory to promote understanding of applications. Topics may include derivative matrices, Taylor polynomials, curvilinear coordi-

nates, Green's theorem, divergence theorem, Stokes's theorem, uniform convergence, operations on series and integrals, improper integrals. Nonmajor graduate credit.

Math 471. Computational Linear Algebra and Fixed Point Iteration. (Same as Com S 471.) (3-0) Cr. 3. F.S. *Prereq:* 265 and either 266, or 267; knowledge of FORTRAN or C. Computational error, solutions of linear systems, least square methods, similarity methods for eigenvalues, non-linear equations, fixed point iteration in one and several variables, Newton's method in several variables. Nonmajor graduate credit.

Math 481. Numerical Solution of Differential Equations and Interpolation. (Same as Com S 481.) (3-0) Cr. 3. S.SS. *Prereq:* 265 and either 266 or 267; knowledge of FORTRAN or C. Orthogonal polynomials, least square and spline methods, numerical differentiation and integration, Euler, Taylor, Runge-Kutta, and predictor-corrector methods for solution of systems of ordinary differential equations. Nonmajor graduate credit.

Math 489. History of Mathematics. (3-0) Cr. 3. S. *Prereq:* 6 credits in mathematics at the 300 level or above. History of mathematical ideas found in the undergraduate curriculum. It includes a discussion of the historical and cultural settings in which these ideas arose, and the influence of the culture on the type of mathematical ideas that developed. Some of the particular cultures and their mathematics that are studied include: Babylonian and Ancient Egyptian, Ancient Greek, Arabic, Indian, Western European and Chinese. Nonmajor graduate credit.

Math 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq:* 301 or 317; 6 credits in mathematics. No more than 9 credits of Math 490 may be counted toward graduation.
H. Honors

Math 491. Undergraduate Thesis. Cr. 2 or 3. Writing a formal mathematics paper. Upon approval by the department, the paper will satisfy the departmental advanced English requirement.

Math 492. Undergraduate Seminar. Cr. 2. S. *Prereq:* Consent of instructor. Introduction to mathematics research. Mathematical presentation, mathematical literature search, participating in seminar on advanced topics in mathematics. Seminar content varies.

Math 497. Teaching Secondary School Mathematics. (Same as C I 497.) (3-0) Cr. 3. F. *Prereq:* 15 credits in college mathematics. Techniques for teaching secondary mathematics students, use of calculators in secondary schools

Math 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of the department cooperative education coordinator; senior classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Math 502. Numerical Analysis I. (3-0) Cr. 3. F. *Prereq:* 414. Numerical linear algebra including eigenvalue problems; numerical solution of nonlinear equations and optimization problems.

Math 503. Numerical Analysis II. (3-0) Cr. 3. S. *Prereq:* 414. Approximation theory, including polynomial interpolation and best approximation; numerical integration; numerical methods for ordinary differential equations.

Math 504. Abstract Algebra. (3-0) Cr. 3. Yr. *Prereq:* 302. First semester of full-year course. Algebraic systems and their morphisms, including groups, rings, modules, and fields.

Math 505. Abstract Algebra. (3-0) Cr. 3. Yr. *Prereq:* 504. Continuation of 504.

Math 507. Numerical Solution of Ordinary Differential Equations. (Same as Com S 507.) (3-0) Cr. 3. F.SS. *Prereq:* 481 or 465 or 415; knowledge of FORTRAN or C. One step methods for initial value problems, one-step methods for systems, multistep

methods, boundary-value problems. Examples using university computers.

Math 510. Linear Algebra. (3-0) Cr. 3. S.SS. *Prereq:* 302 or 307 or 317. Advanced topics in linear algebra including canonical forms, inner product spaces, bilinear forms, tensor products, and applications to other branches of mathematics.

Math 511. Functions of a Single Complex Variable. (3-0) Cr. 3. F. *Prereq:* 465 or 415. Theory of analytic functions, integration, topology of the extended complex plane, singularities and residue theory.

Math 513. Numerical Solution of Integral Equations. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 471 or 509 and a knowledge of FORTRAN or C. Collocation, Galerkin, expansion and product integration methods. First and second kind integral equations, Volterra equations, weakly singular integral equations.

Math 514. Measure Theory. (3-0) Cr. 3. F. *Prereq:* 414. Measure and integration, construction of measures (Lebesgue and Lebesgue-Stieltjes measures), L_p spaces, Hilbert spaces, differentiation, Radon-Nikodym theory, product measures, finite measure spaces. Primarily for non-majors, particularly statistics.

Math 515. Real Analysis I. (3-0) Cr. 3. F. *Prereq:* 414. Measure and integration, differentiation, topology of metric spaces, L^p spaces, Hilbert spaces.

Math 516. Real Analysis II. (3-0) Cr. 3. S. *Prereq:* 515. Elementary theory of Banach spaces. Product integration, Fubini's theorem. Decomposition of measures; differentiation theory. Fourier analysis.

Math 517. Finite Difference Methods. (3-0) Cr. 3. F. *Prereq:* 414. Finite difference methods for parabolic equations; finite difference methods for linear hyperbolic equations and hyperbolic conservation laws; elliptic equations and iterative methods.

Math 518. Finite Element Methods. (3-0) Cr. 3. S. *Prereq:* 414. Elements of functional analysis; Sobolev spaces; variational principles and weak formulations; approximation theory in finite element spaces; analysis of finite element methods; implementation issues; applications.

Math 519. Methods of Applied Mathematics I. (3-0) Cr. 3. F. *Prereq:* 365 or 385 or 426 or 465. Techniques of classical and functional analysis with applications to partial differential equations, integral equations, and boundary value problems for ordinary differential equations.

Math 520. Methods of Applied Mathematics II. (3-0) Cr. 3. S. *Prereq:* 519. Continuation of Math 519.

Math 521. Partial Differential Equations of Applied Mathematics. (3-0) Cr. 3. S. *Prereq:* 365, 385. Solution methods for classical linear partial differential equations. Series methods, Laplace and Fourier transforms, Green's functions. Method of characteristics for first order equations.

Math 522. Perturbation Methods in Applied Mathematics. (3-0) Cr. 3. F. *Prereq:* 307; one of 365, 414. Asymptotic and perturbation methods, asymptotic evaluation of integrals, regular and singular perturbation expansions, WKB method, matched asymptotics and method of multiple scales.

Math 524. Topics in the Application of Mathematics. (3-0) Cr. 3. S. *Prereq:* 307, 385, programming proficiency in Matlab, C, or Fortran. Modeling and applied mathematical techniques for physical applications in science and engineering. Analytical and numerical investigation of current problems from mechanics, acoustics, fluids, and biology; applications from control theory.

Math 525. Numerical Analysis of High Performance Computing. (Same as Com S 525, Cpr E 525.) (3-0) Cr. 3. S. *Prereq:* Cpr E 308, or one of Math 471, 481; experience in scientific programming; knowledge of FORTRAN or C. Development, analysis, and testing of efficient numerical methods for use on current state-of-the-art high performance computers. Applications of the methods to the students' areas of research.

Math 527. Mathematics of Complex Physical Systems. (3-0) Cr. 3. S. *Prereq:* 365 or 426; 385. Classical "molecular" dynamics, stochastic modeling and Monte-Carlo techniques, random walks and diffusion processes, nonlinear dynamics and pattern formation.

Math 531. Introduction to Functional Analysis. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* Permission of instructor. First semester of full-year course. Fundamental theory of normed linear spaces and algebras emphasizing aspects that provide a framework for the study of boundary-value problems, eigenvalue problems, harmonic analysis, analytic function theory, and modern operator theory.

Math 532. Introduction to Functional Analysis. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 531. Continuation of 531.

Math 533. Cryptography. (Same as Cpr E 533.) (3-0) Cr. 3. *Prereq:* Math 301 or Cpr E 310 or Com S 330. Basic concepts of secure communication, DES and IDEA, public-key cryptosystems, elliptic curves, hash algorithms, digital signatures, social and political implications.

Math 534. Topology. (3-0) Cr. 3. F. *Prereq:* Permission of instructor. Introduction to general topology. Emphasizes topics useful in analysis.

Math 537. Algebraic Topology. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 331 or 534; 304. Foundations of algebraic topology. Simplicial complexes. Simplicial and singular homology groups.

Math 540. Seminar in Mathematics Education. (3-0) Cr. 3. Offered on a 3-year cycle, offered SS. 2002. *Prereq:* Enrollment in the master of school mathematics program or professional studies in education. Research studies in mathematics learning and teaching, exemplary practices in mathematics education, and current state and national trends in the mathematics curriculum in grades K-12.

Math 542. Investigating the Teaching and Learning of Secondary Mathematics. (1-0) Cr. 1. Alt. F., offered 2000. *Prereq:* Enrollment in master of school mathematics program, professional studies in education or by permission for secondary mathematics education majors. Research, discussion and evaluation of efforts to improve instruction in the mathematics classroom. Math 542 may be taken for credit multiple times.

Math 543. Seminar in Mathematics Education. (1-0) Cr. 1. F. *Prereq:* Teaching a mathematics course. Selected topics in collegiate mathematics education including cooperative learning, instructional use of technology, writing in mathematics, and cognitive learning theories. Research studies, exemplar practices, and trends in mathematics education.

Math 545. Intermediate Calculus. (4-0) Cr. 4. Offered on a 3-year cycle, offered SS. 2001. *Prereq:* 3 semesters of calculus and enrollment in the master of school mathematics program. Further development of the fundamental concepts of calculus and their applications with an emphasis on a constructivist approach to learning, cooperative groups, problem solving, the use of technology.

Math 546. Algorithms in Analysis and Their Computer Implementation. (2-2) Cr. 3. Offered on a 3-year cycle, offered SS. 2001. *Prereq:* 3 semesters in calculus or concurrent enrollment in 545 and enrollment in the master of school mathematics program. The use of technology in secondary mathematics with an emphasis on the exploration and implementation of algorithms.

Math 547. Discrete Mathematics and Applications. (4-0) Cr. 4. Offered on a 3-year cycle, offered SS. 2000. *Prereq:* Enrollment in the master of school mathematics program. Applications of graph theory, game theory, linear programming, recursion, combinatorics and algebraic structures. Issues in integrating discrete topics into the secondary curriculum. Use of the computer to explore discrete mathematics.

Math 549. Intermediate Geometry. (3-0) Cr. 3. Offered on a 3-year cycle, offered SS. 2000. *Prereq:* 435 or equivalent and enrollment in the master of school mathematics program. A study of geometry

with emphasis on metrics, the group of isometries, the group of similarities, and the affine group. Specific spaces studied normally include the Euclidean plane, the 2-sphere, and projective 2-space. Emphasis on analytical methods.

Math 551. Design Theory and Association Schemes. (3-0) Cr. 3. F. *Prereq:* 301 or 304 or 307 or 317. Combinatorial designs and Latin squares. Construction methods including finite fields. Error-correcting codes. Adjacency matrices and algebraic combinatorics.

Math 552. Enumerative Combinatorics and Ordered Sets. (3-0) Cr. 3. S. *Prereq:* 301 or 304 or 307 or 317. Ordered sets and lattices. Generating functions. Möbius inversion and other enumeration methods.

Math 554. Introduction to Stochastic Processes. (Same as Stat 554.) (3-0) Cr. 3. S. *Prereq:* Stat 542. Markov chains on discrete spaces in discrete and continuous time (random walks, Poisson processes, birth and death processes) and their long-term behavior. Optional topics may include branching processes, renewal theory, introduction to Brownian motion.

Math 555. Theory of Stochastic Processes. (Same as Stat 555.) (3-0) Cr. 3. F. *Prereq:* 514 or 515, Stat 542. Martingales. Markov processes on continuous spaces and their qualitative behavior. Wiener processes. Optional topics may include elementary theory of Ito calculus and diffusions, linear stochastic systems, advanced topics in branching process.

Math 557. Ordinary Differential Equations. (3-0) Cr. 3. F. *Prereq:* 266 or 267; 307 or 317; 415 or 465. First semester of full-year course. The initial-value problem, existence and uniqueness theorems, continuous dependence on parameters, linear systems, stability and asymptotic behavior of solutions, topics from dynamical systems and two-point boundary-value problems.

Math 558. Ordinary Differential Equations. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 557. Continuation of 557.

Math 561. Dynamical Systems. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 414. Smooth mappings and flows on manifolds. Fixed points, stable, unstable and center manifolds, normal forms. Structural stability, bifurcations. Horseshoe maps, introduction to chaotic behavior.

Math 562. Manifolds, Tensors and Differential Geometry. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 414. Geometry of curves and surfaces. Manifolds, coordinate systems. Tensors, differential forms, Riemannian metrics. Connections, covariant differentiation, curvature tensors.

Math 567. Boolean Algebras. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 302 or 421. Structure of Boolean algebras and their representations. Stone spaces and duality. Atomcity, completeness, distributivity, operators, extensions of homomorphisms. Examples and applications from mathematical logic and topology.

Math 571. Mathematical Logic. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 421. First semester of full-year course. Algebraic structures in logical systems, recursive functions, consistency, undecidability and incompleteness of axiomatic theories, results of Gentzen and Gödel, theory of models, ultraproducts and ultralimits, nonstandard analysis.

Math 572. Mathematical Logic. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 571. Continuation of 571.

Math 573. Random Signal Analysis and Kalman Filtering. (Same as Aer E 573, E E 573, M E 573.) (3-0) Cr. 3. F. *Prereq:* 341 or 395 or Aer E 331 or M E 360 or 411. Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

Math 574. Optimal Control. (Same as Aer E 574, E E 574, M E 574.) (3-0) Cr. 3. S. *Prereq:* 577. The optimal control problem. Variational approach.

Pontryagin's principle. Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

Math 575. Introduction to Robust Control. (Same as E E 575.) See *Electrical Engineering*.

Math 576. Digital Feedback Control Systems. (Same as Aer E 576, E E 576, M E 576.) (3-0) Cr. 3. F. *Prereq:* 415 or Aer E 432 or E E 475 or M E 411 or 414; and Math 267. Sampled-data, discrete data, and the z-transform. Design of digital control systems using transform methods: root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

Math 577. Modern Control Systems I. (Same as Aer E 577, E E 577, M E 577.) (3-0) Cr. 3. F. *Prereq:* 415 Aer E 331 or M E 414; and Math 307 or 317. State variable and input-output descriptions of linear continuous-time and discrete-time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems. Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical form dynamical equations. State feedback. State estimators. Decoupling by state feedback. Design of feedback systems. Stability of linear dynamical systems.

Math 578. Modern Control Systems II. (Same as Aer E 578, E E 578, M E 578.) (3-0) Cr. 3. S. *Prereq:* 577. Well-posedness of nonlinear control systems. Approximate analysis methods. Poincaré perturbation method and describing function method. Lyapunov stability theory. Absolute stability of feedback systems. Input-output stability. Large-scale systems.

Math 579. Adaptive Control. (Same as E E 579.) See *Electrical Engineering*.

Math 581. Axiomatic Set Theory. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 414. Axiomatic considerations, model and proof theory, Zermelo-Frankel axioms, classical theorems, transfinite methods, ordinal and cardinal numbers and their arithmetic. Von Neumann-Bernays-Gödel axioms and inaccessible cardinals. Survey of consistency and independence results.

Math 584. Category Theory. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 302. Categories and functors and their applications.

Math 585. Partial Differential Equations. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 415 or 515 or 521. First semester of full-year course. First order equations and systems. General theory of linear partial differential equations including wave, heat and potential equations in several variables; maximum principles, theory of distributions and fundamental solutions. Variational and Hilbert space methods; evolutionary equations and applications of semigroup theory; introduction to the theory of nonlinear equations and systems. One or more of ill posed problems, singularity formation, regularity theory, equations of mixed type, bifurcation theory.

Math 586. Partial Differential Equations. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 585. Continuation of 585.

Math 588. General Theory of Algebraic Structures. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 504. First semester of full-year course. Subalgebras, homomorphisms, congruence relations, and direct products. Lattices and closure operators. Varieties and quasivarieties of algebras, free algebras, Birkhoff's theorems, clones, Mal'cev conditions. Advanced topics.

Math 589. General Theory of Algebraic Structures. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 588. Continuation of 588.

Math 590. Special topics. Cr. var.

Math 594. Introduction to Computational Molecular Biology. (Same as Com S 594 and Gen 594.) (3-0) Cr. 3. S. *Prereq: Biol 301 and 302 or Math 304 and 307 (Math 317 may be used in place of 307) or Com S 311 and 330 or equivalent courses.*

Introduction to the biological background and the algorithms used in sequence comparison and data base search, fragment assembly and physical mapping of DNA, building of phylogenetic trees, analysis of genome rearrangement, and molecular structure prediction. Practice with some of the software commonly used for these problems.

Math 599. Creative Component. Cr. var.

Courses for Graduate Students

Math 610. Seminar. Cr. var.

Math 690. Advanced Topics. Cr. var. *Prereq: Permission of instructor.*

- A. Algebra
- B. Functional Analysis
- C. Measure Theory
- D. Approximation Theory
- E. Linear Algebra
- F. Calculus of Variations
- H. Harmonic Analysis
- I. Combinatorics
- K. Mathematics Education
- L. Logic and Foundations
- M. Complex Analysis
- N. Numerical Analysis
- O. Ordinary Differential Equations
- P. Partial Differential Equations
- Q. Group Theory
- R. Mathematical Physics
- S. Set Theory
- T. Topology
- U. Automata Theory
- V. Optimization Theory
- W. Probability and Stochastic Processes
- Y. Special Functions
- Z. Ring Theory

Math 699. Research.

Mechanical Engineering

Warren R. DeVries, Chair of Department

Professors: Bahadur, Bernard, Brown, Colver, Cook, DeJong, DeVries, Eide, Heising, Molian, Nelson, Okishi, Pate, Pletcher, Shapiro, Wilson

Distinguished Professors (Emeritus): Serovy

Professors (Emeritus): Bathie, Baumgarten, Danofsky, Hall, Hendrickson, Henkin, Junkhan, Kavanagh, Mischke, Peters, Roberts, Spinrad, Wechsler

Associate Professors: Bartlett, Bullen, Flugrad, Garimella, Luecke, Maxwell, Oliver, Prusa, Vance, VanGerpen, VanMeter

Associate Professors (Adjunct): Edelson, Gray

Associate Professors (Emeritus): Joensen

Assistant Professors: Bryden, Fang, Maldonado, Pham, Qamhiyah, Sarma

Assistant Professors (Adjunct): Gassman, Starns

Instructors (Adjunct): Wendt

Undergraduate Study

For the undergraduate curriculum in mechanical engineering leading to the degree bachelor of science, see *College of Engineering*,

Curricula. This curriculum is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

Mechanical engineers are typically involved with such activities as

- generation, distribution, and use of energy
- development and application of manufacturing systems and processes
- automation and control of mechanical and thermal systems
- design of various products for consumer and commercial markets

About one-fourth of all engineers practicing today have been educated as mechanical engineers. Their activities include research, development, design, testing, production, technical sales, and technical management.

Mechanical engineers are characterized by personal creativity, breadth of knowledge, and versatility. For these reasons they are found to function and thrive as valuable members and leaders of multidisciplinary teams. Through clever use of analysis, modeling, design, synthesis, and interpersonal skills they solve important problems to improve our world.

The overall objective of the curriculum in mechanical engineering is *to prepare students for lifelong learning and growth in careers as mechanical engineers in the rapidly-changing industrial world.*

Upon successfully completing the mechanical engineering curriculum, students will be prepared for immediate entry into the field or for further study at the graduate level.

The mechanical engineering curriculum is organized to provide students with a broad foundation in mathematics and the sciences of physics and chemistry.

•Through courses in these subjects, students will attain the basic knowledge required to understand and analyze mechanical engineering systems.

This background is extended and organized through studies in solid mechanics, fluid mechanics, thermodynamics, heat transfer, materials, and electrical applications.

•Upon completion of courses in these areas of the curriculum, students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.

A major focus throughout the mechanical engineering curriculum is a series of experiences that emphasize engineering design.

•In all courses students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.

In addition, a sequence of courses emphasizing engineering design begins in the first year and culminates with a capstone design experience.

•Students will not only be able to apply their engineering knowledge to real-life design problems but also to critically evaluate the solutions.

Development of skills needed to be independent, creative thinkers, effective communica-

tors, and contributing team members is emphasized throughout the curriculum.

•Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries. They will be aware of social and environmental aspects of engineering, as well as the ethical standards of the engineering profession.

The curriculum provides flexibility to allow students to broaden their perspectives or to focus in more depth in areas of particular interest. Organized sequences of technical electives can be chosen from areas which represent major concentrations in the field of mechanical engineering. Optional areas of specialization include energy conversion and utilization, thermal system design, mechanical system design, materials and manufacturing, nuclear engineering, thermal and environmental engineering, and vehicle propulsion.

•Elective courses provide additional emphasis in terms of the student's unique educational goals, whether they include immediate entry into industry or further study at the graduate level.

In addition, students elect courses in the humanities, social sciences, U.S. diversity and international perspectives.

•Through these courses, students develop an understanding of the societal context in which they will practice engineering, including environmental, legal, aesthetic, and human aspects.

Students in mechanical engineering are encouraged to participate in the cooperative education program or to obtain engineering internships, both in the United States and abroad. Study abroad is also encouraged, and the department has exchange programs with several universities around the world. These experiences help students to round out their education and to better prepare for careers in the increasingly global practice of engineering.

Graduate Study

The department offers work for the degrees master of science, and doctor of philosophy with major in mechanical engineering. The master of science degree may be earned with or without thesis. Although co-major and formal minor programs are not offered in mechanical engineering, courses may be used for minor work by students taking major work in other departments.

The graduate program offers advanced study, including design and research, in fluid mechanics, turbomachinery, fluid power, controls, heat transfer, machines and systems, materials and manufacturing processes, thermodynamics and energy utilization. Instrumentation, design of experiments, and computational methods may be applied to any of these areas.

The department offers students the opportunity to broaden their education by participating in minor programs in established departments, interdepartmental programs, or other experiences as approved by their program of study committees.

The requirements for advanced degrees are established by the student's program of study committee within established guidelines of the Graduate College. Graduate students who have not completed an undergraduate program of study substantially equivalent to that required of undergraduate students in the department can expect that additional supporting coursework will be required. A foreign language requirement exists for the degree doctor of philosophy only if the student's program of study committee deems it appropriate to a specific program of study.

Courses open for nonmajor graduate credit: All 300 and 400 level courses except 302, 330, 387, 397, 398, 440, 466, 490, and 498.

Courses Primarily for Undergraduate Students

M E 102. Mechanical Engineering Orientation. (1-0) Cr. R. F.S. Information concerning university, college, and departmental policies and procedures. Information on cooperative, intern, summer and career placement. Review of degree audit and registration.

M E 202. Mechanical Engineering Seminar. (1-0) Cr. R. F.S. *Prereq:* *Sophomore classification.* Technical seminar.

M E 231. Engineering Thermodynamics I. (3-0) Cr. 3. F.S. *Prereq:* *Math 265, Chem 167, Phys 222.* Fundamental concepts based on zeroth, first and second laws of thermodynamics. Properties and processes for ideal gases and solid-liquid-vapor phases of pure substances. Applications to power cycles. Credit for only one course in each of the following groups of courses may be applied toward graduation: 330, 231; 440, 442. The following courses are for students who are not in the mechanical engineering program: 330, 440. Credit in these courses will not be counted toward a degree in mechanical engineering.

M E 270. Introduction to Mechanical Engineering Design. (1-6) Cr. 3. F.S. *Prereq:* *Engr 170, Phys 222.* Introduction to fundamentals of mechanical engineering design with applications to thermal and mechanical systems. Examination of existing machines and systems. Team-based projects, open-ended problems and prototyping. Application of engineering tools such as cost analysis, statistical decision making, codes and standards, and mapping customer needs to technical specifications. Oral and written reports required.

M E 298. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of department chair; sophomore classification.* Required of all cooperative students. Students must register for this course prior to commencing each work period.

M E 324. Manufacturing Engineering. (3-2) Cr. 4. F.S. *Prereq:* *Mat E 272, E M 306.* Plastic deformation and work hardening. Manufacturing processes including forming, machining, casting and welding with emphasis on manufacturing considerations in design. Quality control and computer integration issues. Laboratory exercises, held every two weeks, will be an integral component of the course. Nonmajor graduate credit.

M E 325. Mechanism and Machine Design. (4-0) Cr. 4. F.S. *Prereq:* *Engr 170, E M 345, Stat 305.* Philosophy of design and design methodology. Design of mechanisms including linkages, cams and gear trains. Analysis, selection and synthesis of machine elements. Computer-aided design and introduction to optimization methods. Nonmajor graduate credit.

M E 330. Thermodynamics. (3-0) Cr. 3. F.S. *Prereq:* *Math 265, Phys 222.* For students electing one course in engineering thermodynamics. First and second laws of thermodynamics. Properties and processes for pure substances. Selected applications including cycles for power and refrigeration. Psychrometrics. Credit for only one course in each of the following groups of courses may be applied

toward graduation: 330, 231; 440, 442. The following courses are for students who are not in the mechanical engineering program: 330, 440. Credit in these courses will not be counted toward a degree in mechanical engineering.

M E 332. Engineering Thermodynamics II. (3-0) Cr. 3. F.S. *Prereq:* *231.* Fundamentals of gas mixtures, psychrometry, and thermochemistry. Applications to one-dimensional compressible flow, refrigeration, air conditioning and combustion processes. Nonmajor graduate credit.

M E 335. Fluid Flow. (3-2) Cr. 4. F.S. *Prereq:* *332, E M 345, Math 266 or 267, credit or enrollment in 370 and Engl 314.* Incompressible and compressible fluid flow fundamentals. Dimensional analysis and similitude. Internal and external flow applications. Lab demonstrations and experiments emphasizing concepts in thermodynamics and fluid flow. Written reports are required. Nonmajor graduate credit.

M E 370. Engineering Measurements and Instrumentation. (2-3) Cr. 3. F.S. *Prereq:* *E E 442, Stat 305.* Fundamentals of design, selection, and operation of components of measuring systems. Measurement processes, data acquisition systems, analysis of data, and propagation of measurement uncertainty. Nonmajor graduate credit.

M E 396. Summer Internship for International Students. Cr. R. SS. *Prereq:* Permission of Department Chair. Summer professional work period for international students.

M E 397. Engineering Internship. Cr. R. F.S. *Permission of department chair.* Professional work period, one semester maximum per academic year.

M E 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of department chair; junior classification.* Required of all cooperative students. Students must register for this course prior to commencing each work period.

M E 410. Mechanical Engineering Applications of Mechatronics. (2-2) Cr. 3. S. *Prereq:* *E E 442, 448, credit or enrollment in 421.* Fundamentals of sensor characterization, signal conditioning and motion control, coupled with concepts of embedded computer control. Digital and analog components used for interfacing with computer controlled systems. Mechanical system analysis combined with various control approaches. Focus on automation of hydraulic actuation processes. Laboratory experiences provide hands-on development of mechanical systems. Nonmajor graduate credit.

M E 411. Automatic Controls. (2-2) Cr. 3. F. *Prereq:* *421.* Methods and principles of automatic control. Pneumatic, hydraulic, and electrical systems. Representative applications of automatic control systems. Mathematical analysis of control systems. Nonmajor graduate credit.

M E 412. Legal and Environmental Considerations in Design. (3-0) Cr. 3. F. *Prereq:* *Credit or enrollment in 325, senior classification in engineering.* Failure modes associated with product environment. Interaction between the legal profession, legislative bodies, standards and the design engineer, using a case study approach in design applications. Litigation involving designs, standards, and laws applicable to specific designs surveyed. The influence of laws and standards upon design. Nonmajor graduate credit.

M E 413. Practical Fluid Power Circuits. (Same as A E 413.) (0-3) Cr. 1. F. *Prereq:* *Credit or enrollment in 414 or A E 447.* Properties of fluids. Pump and motor efficiencies. Analysis and assembly of fluid power systems and experimental investigation of appropriate control systems. Application to hydrostatic transmissions. Field trip fee. Nonmajor graduate credit.

M E 414. Hydraulic Systems and Control. (3-0) Cr. 3. F. *Prereq:* *421, 335.* Characteristics of hydraulic motors and pumps, system components, system analysis, feedback control and stability, control circuits, computer simulation. Nonmajor graduate credit.

M E 415. Mechanical Systems Design. (0-6) Cr. 3. F.S. *Prereq:* *324, 325, 421.* Solution of a total design problem involving a mechanical system, document-

ing decisions concerning form and function, material specification, manufacturing methods, safety, cost, and conformance with codes and standards. Solution description includes oral and written reports. Nonmajor graduate credit.

M E 417. Advanced Machine Design I. (3-0) Cr. 3. S. *Prereq:* *325.* Continuation of 325 involving some additional elements, alternative viewpoints, and computational considerations. Analysis, selection, synthesis, and redesign of machine elements using computer and CAD/CAM assistance. Nonmajor graduate credit.

M E 418. Mechanical Considerations in Robotics. (2-2) Cr. 3. S. *Prereq:* *421.* Three dimensional kinematics, dynamics, and control of robot manipulators, hardware elements and sensors. Laboratory experiments using industrial robots. Nonmajor graduate credit.

M E 419. Computer-Aided Design. (2-2) Cr. 3. F. *Prereq:* *325.* Theory and applications of computer-aided design. Design theory, solid modeling and finite element modeling in CAD. Assembly modeling, rapid prototyping and mechanism analysis. Curves and surfaces and CAD/CAM data exchange. Nonmajor graduate credit.

M E 421. Mechanical Systems and Control. (3-2) Cr. 4. F.S. *Prereq:* *E M 345, Math 267, E E 442, 448.* Modeling and simulation of mechanical systems. Development of equations of motion and dynamic response characteristics. Fundamentals of classical control applications, including mathematical analysis and design for closed loop control systems. Introduction to computer interfacing for data acquisition and control. Laboratory exercises for hands-on motion and control implementation. Nonmajor graduate credit.

M E 431. Nuclear Radiation Theory and Engineering. (3-0) Cr. 3. F. *Prereq:* *Phys 222, Math 266 or 267.* Atomic and nuclear physics. Radioactivity and reaction rates. Cross sections. Introduction to neutron diffusion theory. Engineering applications of radiation theory. Nonmajor graduate credit.

M E 432. Nuclear Reactor Theory and Engineering. (3-0) Cr. 3. S. *Prereq:* *431.* Neutron diffusion theory. Reactivity coefficients. Reactor kinetics. Reactor engineering and energy removal. Radiation protection and shielding. Reactor safety. Nuclear power plant licensing and environmental considerations. Nonmajor graduate credit.

M E 436. Heat Transfer. (3-2) Cr. 4. F.S. *Prereq:* *335.* Heat transfer by conduction, convection, and radiation. Similarity concepts in heat, mass, and momentum transfer. Methods for determination of heat transfer coefficients. Combined modes of heat transfer. Heat exchangers. Lab demonstrations and experiments emphasizing concepts in thermodynamics and heat transfer. Written reports are required. Nonmajor graduate credit.

M E 440. Principles of Heating and Air Conditioning. (4-0) Cr. 4. S. *Prereq:* *Phys 222.* Basic principles of thermodynamics, heat transfer, and refrigeration. Computation of building heat loss and heat gain. Principles of air distribution and duct design. Credit for only one course in each of the following groups of courses may be applied toward graduation: 330, 231; 440, 442. The following courses are for students who are not in the mechanical engineering program: 330, 440. Credit in these courses will not be counted toward a degree in mechanical engineering.

M E 441. Fundamentals of Heating, Ventilating, and Air Conditioning. (3-0) Cr. 3. F. *Prereq:* *Credit or enrollment in 436.* Space conditioning and moist air processes. Application of thermodynamics, heat transfer, and fluid flow principles to the analysis of heating, ventilating, and air conditioning components and systems. Performance and specification of components and systems. Nonmajor graduate credit.

M E 442. Heating and Air Conditioning Design. (1-4) Cr. 3. S. *Prereq:* *441.* Design criteria and assessment of building environment and energy requirements. Design of heating, ventilating, and air conditioning systems. System control and economic analysis. Oral and written reports required. Credit for only

one course in each of the following groups of courses may be applied toward graduation: 330, 231; 440, 442. The following courses are for students who are not in the mechanical engineering program: 330, 440. Credit in these courses will not be counted toward a degree in mechanical engineering. Nonmajor graduate credit.

M E 444. Elements and Performance of Power Plants. (3-0) Cr. 3. F. *Prereq:* 332, *credit or enrollment in 436.* Analysis of power supply systems and their components: turbines, steam generators, fans, pumps, heat exchangers and air pollution control equipment. Nonmajor graduate credit.

M E 445. Internal Combustion Engines. (2-2) Cr. 3. F. *Prereq:* 332, *credit or enrollment in 436.* Basic principles, thermodynamics, and performance of spark ignition and compression ignition engines. Engine-drive train-vehicle considerations. Properties of engine fuels, combustion generated air pollutants. Laboratory determination of engine performance. Nonmajor graduate credit.

M E 446. Power Plant Design. (2-3) Cr. 3. S. *Prereq:* 444. Design of a power plant to meet a specified power (energy) demand. Selection and/or synthesis of principal components and pollution control equipment. Oral and written reports required. Nonmajor graduate credit.

M E 447. Gas Turbines. (3-0) Cr. 3. F. *Prereq:* 332, 335. General principles, thermodynamics, and performance of gas turbine engines. Engine components, engine matching, and selection. Environmental considerations. Nonmajor graduate credit.

M E 448. Fluid Dynamics of Turbomachinery. (3-0) Cr. 3. S. *Prereq:* 335. Applications of principles of fluid mechanics and thermodynamics in performance analysis and design of turbomachines and related fluid system components. Nonmajor graduate credit.

M E 449. Internal Combustion Engine Design. (3-0) Cr. 3. S. *Prereq:* 324, 325, 445. Thermodynamic and mechanical design of a spark ignition or compression ignition internal combustion engine to meet specified performance, fuel economy, and air pollution requirements. Oral and written reports required. Nonmajor graduate credit.

M E 451. Engineering Acoustics. (Same as E M 451.) See *Engineering Mechanics*. Nonmajor graduate credit.

M E 466. Multidisciplinary Engineering Design. (Same as A E 466, Cpr E 466, E E 466, E Sci 466, I E 466, Mat E 466.) (1-4) Cr. 3. F.S. *Prereq:* *Student must be within two semesters of graduation and permission of instructor.* Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

M E 475. Modeling and Simulation. (3-0) Cr. 3. S. *Prereq:* 421, *credit or enrollment in 436.* Introduction to computer solution techniques required to simulate flow, thermal, and mechanical systems. Methods of solving ordinary and partial differential equations and systems of algebraic equations; interpolation, numerical integration; finite difference and finite-element methods. Nonmajor graduate credit.

M E 490. Independent Study. Cr. 1 to 6. *Prereq:* *Senior classification.* Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

- C. Engineering Measurements and Instrumentation
- D. Heat Transfer
- E. Fluid Power and Controls
- F. Machines and Systems
- G. Materials and Manufacturing Processes
- H. Honors
- J. Thermodynamics and Energy Utilization
- K. Fluid Mechanics
- L. Turbomachinery
- M. Nuclear Engineering

M E 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of department chair; senior classification.* Required of all cooperative students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

M E 511. Advanced Control Design. (3-0) Cr. 3. S. *Prereq:* 411. Application of control design methods using continuous, discrete, and frequency-based models. Approaches include classical, pole assignment, model reference, internal model, and adaptive control methods. Mechanical design projects.

M E 515. Advanced Machine Design II. (3-0) Cr. 3. F. *Prereq:* 325. Experimental, empirical, and rational methods for analysis and synthesis in the solution of advanced design problems in machine elements. Creep and fatigue considerations.

M E 516. Kinematic Analysis and Synthesis of Mechanisms. (3-0) Cr. 3. S. *Prereq:* 325. Analysis and synthesis of mechanisms using graphical, analytical, and computational methodologies.

M E 517. Contemporary Issues in Computer-Aided Engineering. (3-0) Cr. 3. S. *Prereq:* 325. Philosophy and applications tools of concurrent engineering. Advanced CAD/CAM systems and advances in formal design methods. Computer-aided software engineering and distributed information systems in business. Distributed artificial intelligence and its application to concurrent engineering.

M E 518. Advanced Dynamics of Machinery. (3-0) Cr. 3. F. *Prereq:* 421. Dynamic forces in machine members. Dynamic response of cam-follower systems. Rotating and reciprocating machine unbalance. Forces transmitted and machinery isolation. Computer simulation of dynamic response.

M E 519. Computer Graphics and Geometric Modeling. (Same as Cpr E 519) (3-0) Cr. 3. F. *Prereq:* 421, *programming experience in C.* Fundamentals of computer graphics technology. Data structures. Parametric curve and surface modeling. Solid model representations. Applications in engineering design, analysis, and manufacturing.

M E 520. Material and Manufacturing Considerations in Design. (3-0) Cr. 3. F. *Prereq:* 324, 325. Advanced treatment of materials and manufacturing. Applications to design. Design and redesign to facilitate cost-effective manufacturing. Qualitative and quantitative comparisons of designs. Economic considerations.

M E 521. Mechanical Behavior and Manufacturing of Polymers and Composites. (Same as M S E 521.) (3-0) Cr. 3. S. *Prereq:* 324 or Mat E 271 and E M 324. Effect of chemical structure and morphology on properties. Linear viscoelasticity, damping and stress relaxation phenomena. Structure and mechanics of filler and fiber reinforced composites. Mechanical properties and failure mechanisms. Material selection and designing with polymers. Processing of polymer and composite parts.

M E 522. Computer Integrated Manufacturing. (2-2) Cr. 3. F. *Prereq:* 324 *senior classification.* Study of modern manufacturing techniques in the computer-based environment including Computer Numerically Controlled (CNC) machine tools, programmable logic controllers, material handling and assembly robots, injection molding machines. Reverse engineering using coordinate measuring machines. Rapid prototyping techniques including computer interfaces and laser application. Hands-on experience with laboratory exercises using the equipment in the Engel CIM Laboratory.

M E 523. Computer-Aided Machining Systems. (3-0) Cr. 3. S. *Prereq:* 324. Introduction to advanced technologies in computer-aided machining systems. Numerical modeling of machining processes. Optimal selection and design of cutting tools. Principles of computer numerically controlled (CNC) machines. Design for machining processes. Geometric dimensioning and tolerancing. Assembly techniques and accuracy.

M E 524. Numerical Mesh Generation. (Same as

Aer E 524, E M 524.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* Math 385. Introduction to modern mesh generation techniques. Structured and unstructured mesh methods, algebraic and PDE methods, elliptic and hyperbolic methods, variational methods, error analysis, Delaunay triangulation, data structures, geometric modeling with B-spline and NURBS surfaces, surface meshing.

M E 526. Tribological Considerations in Design and Manufacturing. (3-0) Cr. 3. F. *Prereq:* 324. Contact mechanics and interaction between sliding surfaces. Surface characterization. Friction and wear studies for sliding between metals, polymers and ceramics. Design of bearings and gears. Failure of cutting tools and forming dies. Lubrication in sliding contacts, and machining and forming operations. Failure analysis.

M E 529. Laser Applications in Manufacturing. (2-2) Cr. 3. S. *Prereq:* 324. Principles and theory of lasers. Physics of laser light. Functional description of various types of lasers. Beam delivery including fiberoptics. Laser/material interactions. Laser machining, welding and surface processing. Rapid prototyping using lasers. Economics of laser processing. Case studies. Group project and report submission.

M E 530. Advanced Thermodynamics. (3-0) Cr. 3. F. *Prereq:* 332. Fundamentals of thermodynamics from the classical viewpoint with emphasis on the use of the first and second laws for analysis of thermal systems. Generalized thermodynamic relationships. Computer applications of thermodynamic properties and system analysis. Selected topics.

M E 531. Statistical Thermodynamics for Engineers. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 330 or 231. First and second laws of thermodynamics, properties of gases, liquids, and solids from a microscopic viewpoint. Introduction to non-equilibrium thermodynamics. Onsager relationships and determination of transport properties.

M E 532. Thermodynamics of Compressible Flow I. (3-0) Cr. 3. F. *Prereq:* 335. Thermodynamics of internal compressible flow. One dimensional steady flow; isentropic flow, normal shock waves, constant area flow with friction and heat transfer. Generalized one dimensional flow.

M E 533. Thermodynamics of Compressible Flow II. (Same as Aer E 533.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 532 or Aer E 411. Theory of unsteady compressible flow and steady two dimensional supersonic internal flow. Compression and expansion waves and wave interactions. Applications.

M E 536. Advanced Heat Transfer. (3-0) Cr. 3. S. *Prereq:* 436. Advanced treatment of heat transmission by conduction, convection, and radiation.

M E 538. Advanced Fluid Flow. (3-0) Cr. 3. F. *Prereq:* *Credit or enrollment in 436.* Detailed analysis of incompressible/compressible, viscous/inviscid, laminar/turbulent, and developing fluid flows on a particle/point control volume basis.

M E 539. Fluidized Bed Processes. (Same as Ch E 539.) (3-0) Cr. 3. F. *Prereq:* 436 or Ch E 357. Mass, momentum, and energy balances applied to fluidized beds. Hydrodynamics of bubbling, turbulent, and fast fluidized beds. Heat and mass transfer. Thermal and chemical processes in fluidized beds. Applications.

M E 540. Solar Energy Thermal Systems. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 436. Application of heat transfer and thermodynamics to the design and analysis of solar energy collectors and systems.

M E 542. Advanced Combustion. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 332 or Ch E 381. Thermochemistry and transport theory applied to combustion. Gas phase equilibrium. Energy balances. Reaction kinetics. Flame temperatures, speed, ignition, and extinction. Premixed and diffusion flames. Combustion aerodynamics. Mechanisms of air pollution.

M E 545. Thermal Systems Optimization. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 436. Modeling thermal equipment and simulating thermal systems. Cost estimating and life cycle analysis. Second law

analysis. Optimization techniques for thermal systems.

M E 546. Computational Fluid Mechanics and Heat Transfer I. (Same as Aer E 546.) (3-0) Cr. 3. F. *Prereq:* Credit or enrollment in 538 or Aer E 541 or E M 571. Introduction to finite difference and finite volume methods used in modern engineering. Basic concepts of discretization, consistency, and stability. Applications of numerical methods to selected model partial differential equations.

M E 547. Computational Fluid Mechanics and Heat Transfer II. (Same as Aer E 547.) (3-0) Cr. 3. S. *Prereq:* 546. Application of computational methods to current problems in fluid mechanics and heat transfer. Methods for solving the Navier-Stokes and reduced equation sets such as the Euler, boundary layer, and parabolized forms of the conservation equations. Introduction to relevant aspects of grid generation and turbulence modeling.

M E 548. Turbomachinery. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 448. Intermediate level study of turbomachines and related fluid system components. Aerodynamic and aeromechanical performance and design considerations.

M E 549. Vehicle Dynamics. (3-0) Cr. 3. F. *Prereq:* E M 345, Math 266 or 267. Analysis and evaluation of the performance of cars and trucks. Computer simulation of ride, braking, and directional response.

M E 551. Signal Processing in Mechanics. (Same as E M 551.) (2-2) Cr. 3. S. *Prereq:* E M 444 or 451, Math 385. Classification and measurement of time dependent phenomena in mechanics. Correlation, spectral, and probabilistic techniques for the analysis of acoustical, vibrational, and unsteady fluid dynamic phenomena. Selected laboratory experiments emphasizing dual channel FFT analyzer applications in mechanics.

M E 564. Fracture and Fatigue. (Same as E M 564, M S E 564.) (3-0) Cr. 3. F. *Prereq:* E M 324 and one of E M 336, E Sci 352, Mat E 211 or 271. Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics. Fracture and fatigue tests, thermal fracture, mechanics and materials designed to avoid fracture and fatigue.

M E 573. Random Signal Analysis and Kalman Filtering. (Same as Aer E 573, E E 573, Math 573.) (3-0) Cr. 3. F. *Prereq:* 370 or 411 or Aer E 431 or E E 321 or Math 341 or 395. Elementary notions of probability. Random processes. Autocorrelation and spectral functions. Estimation of spectrum from finite data. Response of linear systems to random inputs. Discrete and continuous Kalman filter theory and applications. Smoothing and prediction. Linearization of nonlinear dynamics.

M E 574. Optimal Control. (Same as Aer E 574, E E 574, Math 574.) (3-0) Cr. 3. *Prereq:* 577. The optimal control problem. Variational approach. Pontryagin's principle. Hamilton-Jacobi equation. Dynamic programming. Time-optimal, minimum fuel, minimum energy control systems. The regulator problem. Structures and properties of optimal controls.

M E 575. Introduction to Robust Control. (Same as Aer E 575, E E 575, Math 575.) (3-0) Cr. 3. *Prereq:* 577. Introduction to modern robust control. Model and signal uncertainty in control systems. Uncertainty description. Stability and performance robustness to uncertainty. Solutions to the H_2 , H_∞ , and I_1 control problems. Tools for robustness analysis and synthesis.

M E 576. Digital Feedback Control Systems. (Same as Aer E 576, E E 576, Math 576.) (3-0) Cr. 3. *Prereq:* 411 or 414 or Aer E 432 or E E 475 or Math 415; and Math 267. Sampled data, discrete data, and the z -transform. Design of digital control systems using transform methods: root locus, frequency response and direct design methods. Design using state-space methods. Controllability, observability, pole placement, state estimators. Digital filters in control systems. Microcomputer implementation of digital filters. Finite wordlength effects. Linear quadratic optimal control in digital control systems. Simulation of digital control systems.

M E 577. Modern Control Systems I. (Same as 1999-2001

Aer E 577, E E 577, Math 577.) (3-0) Cr. 3. F. *Prereq:* 414 or Aer E 331 or Math 415; and Math 307. State variable and input-output descriptions of linear continuous-time and discrete-time systems. Solution of linear dynamical equations. Controllability and observability of linear dynamical systems. Canonical descriptions of linear equations. Irreducible realizations of rational transfer function matrices. Canonical form dynamical equations. State feedback. State estimators. Decoupling by state feedback. Design of feedback systems. Stability of linear dynamical systems.

M E 578. Modern Control Systems II. (Same as Aer E 578, E E 578, Math 578.) (3-0) Cr. 3. *Prereq:* 577. Well-posedness of nonlinear control systems. Approximate analysis methods. Poincaré perturbation method and describing function method. Lyapunov stability theory. Absolute stability of feedback systems. Input-output stability. Large-scale systems.

M E 579. Adaptive Control. (Same as Aer E 579, E E 579, Math 579.) (3-0) Cr. 3. *Prereq:* 577. Fundamentals of adaptive control: terminology, parameter identification, basic adaptive controller design techniques, analysis of stability, parameter convergence, and robustness. Nonlinear adaptive control. Application examples.

M E 581. Nuclear Reactor Thermal-Hydraulic Analysis. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 432, 436. Reactor heat generation and removal. Water, gas, and liquid metal heat transfer for nuclear reactors. Thermal limits and margins. Thermal stresses in reactor components.

M E 582. Nuclear Power Systems. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 581. Reactor power cycles. Engineered safety systems. Advanced reactors and passive safety designs.

M E 583. Computational Methods in Nuclear Engineering. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* Math 481. Application of numerical modeling techniques for the analysis of nuclear reactor core neutronics and thermal-hydraulic systems. Use of computational models in design.

M E 584. Radiological Engineering. (3-0) Cr. 3. Alt. F., offered 2001. *Prereq:* 431. Radiation dosimetry and shielding. Radiation protection standards and regulations. Environmental impacts of radiation applications. Medical, agricultural and industrial utilization of radiation.

M E 585. Radioactive Waste Management. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 584. Management of high-level, low-level, transuranic, and mixed wastes. Technical challenges related to safe handling, shipment, treatment and disposal. Source term evaluation, engineered barrier system design and performance assessment model development and evaluation.

M E 590. Special Topics. Cr. 1 to 8.

- A. Experimental Gas Dynamics
- B. Fluid Mechanics
- C. Heat Transfer
- D. Thermodynamics and Energy Utilization
- E. Turbomachinery
- F. Vehicular Propulsion Systems
- G. Advanced Machine Design
- I. Automatic Controls
- J. Operating and Environmental Considerations in Design
- K. Mechanical Behavior of Materials
- L. Manufacturing Processes
- M. Tribology
- N. Sensitivity Methods
- O. Engineering Computation
- P. Engineering Measurements and Instrumentation
- Q. Independent Literature Investigation
- R. Nuclear Engineering

M E 599. Creative Component. Cr. var.

Courses for Graduate Students

M E 600. Seminar. (1-0) Cr. R. F.

M E 621. Artificial Neural Networks. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* E E 545. Basic and advanced discussions of artificial neural networks (ANNs), ANN design, modeling of data with ANNs,

pattern recognition, fault diagnosis, importance of input variables, information theory and statistics applied data sets. The course is applications oriented.

M E 625. Surface Modeling. (3-0) Cr. 3. S. *Prereq:* 519, programming experience in C. Theory and implementation of contemporary parametric sculptured surface modeling technology. Non-uniform rational B-spline (NURBS) curves and surfaces. Fundamental computational algorithms. Construction techniques. Advanced modeling topics. Computer projects.

M E 630. Nonequilibrium Thermodynamics. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 530, 538. Nonequilibrium concepts in thermodynamics with applications in fluid mechanics and heat and mass transfer. Onsager relations, entropy generation in irreversible processes, nonequilibrium states and properties, reacting and two-phase flows.

M E 632. Particulate Flow. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 436. Concepts in single and multiparticle phenomena: particle interactions with fluids, other particles and walls; equations of multiphase ducted flow. Dense packing particle behavior including heat and mass transfer in fixed and fluidized beds.

M E 636. Conduction Heat Transfer. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 436. Techniques for analysis of problems involving steady-state and transient heat conduction in solids.

M E 637. Convection Heat Transfer. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 436. Heat transfer to internal or external forced convection flows under laminar or turbulent conditions. Free convection. Heat exchanger design considerations, including augmentation.

M E 638. Radiation Heat Transfer. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 436. Techniques for analysis of radiation in enclosures. Radiative properties of surfaces. Radiative transfer in participating media. Combined modes of transfer. Approximate methods of analysis.

M E 639. Two-Phase Flow and Heat Transfer. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 436. Hydrodynamics of adiabatic two-phase flow. Pool boiling. Forced convection, boiling, and condensation. Dynamic behavior of two-phase systems. Augmentation of boiling and condensing heat transfer. Applications in the power and process industries.

M E 646. Computational Methods for Internal and Low Speed Flows. (Same as Aer E 646.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 547. Emphasis is on algorithms suitable for low speed and internal flows at speeds up through transonic. Topics include pressure-based schemes, pseudo-compressibility methods, use of preconditioning to develop algorithms suitable for all speed regimes, large eddy simulation, algorithms for unstructured grids, and finite elements in fluids.

M E 647. Advanced High Speed Computational Fluid Dynamics. (Same as Aer E 647.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 547. An examination of current methods in computational fluid dynamics. Differencing strategies. Advanced solution algorithms. Grid generation. Construction of complex CFD algorithms. Current applications. Use of state of the art CFD codes.

M E 651. Advanced Topics in Fluid Mechanics. (Same as E M 651.) See *Engineering Mechanics*.

M E 690. Advanced Topics. Cr. var. Investigation of advanced topics of special interest to graduate students in mechanical engineering. Topic areas are those listed for M E 590.

M E 699. Research. Offered on a satisfactory-fail grading basis only.

Courses in History of Technology and Science

M E 280. Introduction to History of Science. (Same as Hist 280.) (3-0) Cr. 3. F. Ideas of nature from Babylonian to the Renaissance.

M E 281. Introduction to History of Science. (Same as Hist 281.) (3-0) Cr. 3. S. Science from the seven-

teenth-century scientific revolution to Darwin and Einstein.

M E 284. Introduction to History of Technology and Engineering. (Same as Hist 284.) (3-0) Cr. 3. F. Technology in various civilizations including from Sumer and Egypt to early 18th century Europe.

M E 285. Introduction to History of Technology and Engineering. (Same as Hist 285.) (3-0) Cr. 3. S. Technology in the Western world in the nineteenth and twentieth centuries.

M E 387. Technology, Science, and Society in Modern Europe. (Same as Hist 387.) (3-0) Cr. 3. Wilson. From the late eighteenth-century beginnings of the industrial revolution in Britain to World War I. Examination of scientists' and engineers' influence on society and of society on them.

M E 485. History of Physics and Physical Engineering. (Same as Hist 485.) (3-0) Cr. 3. Wilson. Interactions between the science of physics and the branches of engineering associated with it, from the post-Newtonian era to the age of Einstein. Nonmajor graduate credit.

M E 488. History of American Technology. (Same as Hist 488.) (3-0) Cr. 3. Cravens, Bix. Technology in America from Industrial Revolution to present. Themes include social contexts of technological change, development of professional engineering, ideas about technology and American life. Nonmajor graduate credit.

M E 489. History of American Science. (Same as Hist 489.) (3-0) Cr. 3. Cravens. Science and its social relationships since the mid-nineteenth century; interaction of scientific discoveries and the development of society. Continuing impact of Darwinism and other scientific theories; science and social thought; modern medicine and public health; science and industry; science and agriculture; the social sciences; government and science; science and the consumer; the atomic age; big science and the environmental dilemma; the energy crisis; the role of science in a democracy. Nonmajor graduate credit.

Meteorology

For description of courses, see *Geological and Atmospheric Sciences*.

Microbiology

www.micro.iastate.edu/index

James S. Dickson, Chair of Department

Professors: Harris, Pometto

Professors (Emeritus): Durand, Kraft, Pattee, Quinn, Williams

Associate Professors: Andrews, Bazylnski, Cunnick, Dickson, Dispirito

Associate Professors (Collaborators): Moorman, Zuerner

Assistant Professors: Beattie, Halverson, Hoyle, Phillips

Undergraduate Study

The department offers undergraduate study for the bachelor of science degree with a major in microbiology. For the curriculum in microbiology, see *Agriculture, Curricula*. In this department, principal emphasis is placed on understanding microorganisms and their interrelationships with other organisms in nature, the application of microbiology in medicine, agriculture and industry, and the study of fundamental life processes as exemplified by microorganisms. Some fields of microbiology, especially advanced research, may require further training. Undergraduate work in the

department is designed to provide sound preparation for graduate study, training for bachelors-level employment, and admission to professional programs such as medicine, veterinary medicine and dentistry.

Graduates of the Department of Microbiology are able to recognize and appreciate the diversity and complexity of microbial life represented by prokaryotes, eukaryotes, and viruses. In addition to understanding fundamental principles of microbial growth, physiology, genetics, biochemistry, and ecology, the impact that the microbial world has on human, animal and plant health, as well as on industry and biotechnology is grasped. Graduates are able to design and implement experimental approaches to address specific questions. In addition, graduates are able to communicate scientifically, by a variety of media.

Graduate microbiologists find career opportunities in a wide variety of areas: in hospital and clinical laboratories; in federal, state, and local government agencies; in research and development; in dairy and food processing; in the pharmaceutical and fermentation industries.

Undergraduate programs for the major in microbiology usually include the following basic courses: 302, 310, 320, 341, 342, 343, 344, 345, 441, 442, 443, 444, 445, and 446. Aspects of these courses emphasize communication skills, environmental issues, problem solving, and laboratory techniques. Courses in the following areas are required as supporting work: biology, chemistry, biochemistry, genetics, mathematics, physics, speech.

Preveterinary preparation may be accomplished through the curriculum major in this department (see *College of Veterinary Medicine, Admission Requirements*).

Students majoring in microbiology are eligible to apply for the Cooperative Education Program with the Agricultural Research Service. If selected, the student will obtain full-time, paid, work experience at either the National Animal Disease Center, the National Veterinary Services Laboratory, or the Soil Tilth Laboratory in Ames. Other internship opportunities also are available.

The department offers a minor in microbiology which may be earned by accumulating a minimum of 15 credits from the departmental offerings.

Majors in microbiology must take courses in written communication (Engl 104, 105), one course in oral communication (Sp Cm 212), and must meet the College of Agriculture English proficiency requirement of C or better in these courses. Students must also meet the College of Agriculture requirements for credit in courses in ethics, and the university diversity and multicultural requirements.

Graduate Study

The department offers work toward the degrees master of science and doctor of philosophy, and minor work to students majoring in other departments. A non-thesis master's option is available for the major in microbiology.

Graduates in the Microbiology program have a strong broad-based general knowledge of microbiology as well as advanced knowledge in a specific aspect of microbiology. Those students completing a thesis have the technical research, critical thinking, problem solving, and computer skills to design, implement, and conduct research experimentation using a variety of modern molecular tools and equipment. They are able to communicate research results effectively with scientific peer groups in both oral and written formats.

Prerequisite to graduate study is completion of coursework in general microbiology, biology, biochemistry, mathematical sciences, and physics.

The department also participates in the interdepartmental majors and programs in genetics, immunobiology, MCDB (molecular, cellular, and developmental biology), neuroscience, technology and social change, toxicology, and water resources (see *Index*).

Each graduate student must demonstrate proficiency in English composition within two semesters in residence.

Courses open for nonmajor graduate credit: 310, 374, 406, 419, 420, 421, and 485.

Courses Primarily for Undergraduate Students

Micro 110. Orientation in Microbiology. (1-0) Cr. 1. F. Orientation to the discipline of microbiology, the curriculum in microbiology, and educational research opportunities within the department. Offered on a satisfactory-fail basis only.

Micro 201. General Microbiology. (2-0) Cr. 2. F.S. *Prereq: One semester of college-level biology.* Selected topics in microbiology with emphasis on the relationship of microorganisms to animal health, agricultural technology, and the environment. Students who obtain a grade of B or better may substitute 201 for 302 in advanced courses. Credit for either 201 or 302, but not both, may be applied toward graduation.

Micro 201L. Introductory Microbiology Laboratory. (0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in 201 or 302.* Materials fee.

Micro 302. Biology of Microorganisms. (3-0) Cr. 3. F.S. *Prereq: Biol 201, credit or enrollment in Biol 202; 1 semester of chemistry.* The characteristics of microorganisms and their roles in disease, in the environment, and in industry. Credit for either 302 or 201, but not both, may be applied toward graduation.

Micro 310. Fundamentals of Microbial Infection and Immunity. (4-0) Cr. 4. F. *Prereq: 302.* Study of pathogenic microbes, mechanisms of disease, and host resistance. Nonmajor graduate credit.

Micro 311. Introduction to Parasitology. (Same as Zool 311.) See *Zoology*.

Micro 320. Fundamentals of Microbial Physiology and Genetics. (4-0) Cr. 4. S. *Prereq: 302, Biol 301, a course in organic chemistry.* Introductory course in microbial physiology and genetics with emphasis on the structure, function, and assembly of bacterial cell components, metabolism, regulation of gene expression, genetic adaptation, and growth.

Micro 341. Bacterial Cultivation Techniques. (0-6) Cr. 1. F. *Prereq: Credit or enrollment in 302.*

Techniques for the cultivation of bacteria in solid and liquid media and under diverse environmental conditions, including aerobic and anaerobic conditions; culture preservation techniques; and technique for determining culture purity. Materials fee.

Micro 342. Techniques for the Visualization and Fractionation of Bacterial Cells. (0-6) Cr. 1. F. *Prereq: Credit or enrollment in 302.* Light microscopy techniques, including phase, dark-field, and fluores-

cence microscopy; determinative and cytological light microscopy; spectroscopy; and cell collection, purification and fractionation. Materials fee.

Micro 343. Techniques for Studying Bacterial Growth. (0-6) Cr. 1. F. *Prereq:* *Credit or enrollment in 302.* Techniques for enriching and isolating bacteria, for measuring bacterial growth, and for examining physicochemical factors affecting bacterial growth. Materials fee.

Micro 344. Electrophoretic Techniques. (0-6) Cr. 1. S. *Prereq:* *Credit or enrollment in 302.* Electrophoretic techniques for the study of proteins and nucleic acids. Materials fee.

Micro 345. Techniques in Microbial Systematics. (0-6) Cr. 1. S. *Prereq:* *Credit or enrollment in 302.* Techniques for the identification and classification of microorganisms based on phenotypic, genotypic, and phylogenetic relatedness. Materials fee.

Micro 374. Insects and Our Health. (Same as Ent 374.) See *Entomology*. Nonmajor graduate credit.

Micro 402. Microbial Genetics. (Dual-listed with 502.) (3-0) Cr. 3. F. *Prereq:* *320.* Microbial and bacteriophage genetics; emphasis on mutagenesis, mechanisms of genetic exchange genetic analysis of cellular mechanisms, and an introduction to genetic engineering.

Micro 404. Microbial Physiology. (Dual-listed with 504.) (3-0) Cr. 3. S. *Prereq:* *320.* Topics in microbial physiology, including structure and function of cell components, bioenergetics, diversity, life in extreme environments growth, adaptation and regulation.

Micro 406. Principles of Mycology. (Same as Bot 406.) See *Botany*. Nonmajor graduate credit.

Micro 407. Microbiological Safety of Foods of Animal Origins. (Dual-listed with 507, same as FS HN 407.) (3-0) Cr. 3. S. *Prereq:* *420.* Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

Micro 408. Virology. (Dual-listed with 508.) (3-0) Cr. 3. F. *Prereq:* *310.* The biology of animal, plant and insect viruses.

Micro 419. Foodborne Hazards. (Same as FS HN 419.) See *Food Science and Human Nutrition*. Nonmajor graduate credit.

Micro 420. Food Microbiology. (Same as FS HN 420, Tox 420.) (3-0) Cr. 3. F. *Prereq:* *302.* Effects of microbial growth in foods. Methods to control, detect, and enumerate microorganisms in food and water. Foodborne infections and intoxications. Nonmajor graduate credit.

Micro 421. Food Microbiology Laboratory. (Same as FS HN 421.) (1-6) Cr. 3. F. *Prereq:* *201 or 302; 201L. Credit or enrollment in 420 (FS HN 420).* Standard microbiological techniques employed in the food industry, including microscopic examination of foods, plate counts, other enumeration methods, indicator organisms of food quality and safety, foodborne pathogens, and molds. Materials fee. Nonmajor graduate credit.

Micro 425. Food Biotechnology. (Dual-listed with 525; same as FS HN 425.) See *Food Science and Human Nutrition*.

Micro 441. Techniques in Bacterial Genetics. (0-6) Cr. 1. F. *Prereq:* *Credit or enrollment in 320.* Techniques involved in the mutation and transfer of genes in bacteria. Materials fee.

Micro 442. Techniques for Studying Bacterial Metabolism. (0-6) Cr. 1. F. *Prereq:* *Credit or enrollment in 320.* Techniques for the analysis of bacterial cell metabolism based on chemical and physical analytical methods and measurements of enzyme activity, permeability, and transport. Materials fee.

Micro 443. Techniques for the Purification and Isolation of Proteins. (0-6) Cr. 1. F. *Prereq:* *Credit or*

enrollment in 320. Techniques for the isolation and purification of soluble and membrane proteins. Materials fee.

Micro 444. Techniques in Molecular Biology. (0-6) Cr. 1. S. *Prereq:* *Credit or enrollment in 320.* Techniques for the isolation of plasmid and chromosomal DNA from bacteria, the cloning and amplification of genes, and the analysis of gene expression. Materials fee.

Micro 445. Eukaryotic Cell Culture and Function. (0-6) Cr. 1. S. *Prereq:* *Credit or enrollment in 310.* Techniques in primary culture and tumor cell growth, measures of lymphocyte function, and flow cytometry. Materials fee.

Micro 446. Antibody Techniques for Studying Eukaryotic and Prokaryotic Cells. (0-6) Cr. 1. S. *Prereq:* *Credit or enrollment in 310.* Animal immunization methods and serological techniques, including precipitation and agglutination reactions, enzyme-linked immunosorbent assays, and immunodetection. Materials fee.

Micro 450. Undergraduate Seminar. Cr. 1 each time taken. F. *Prereq:* *Sp Cm 212.* Required of all undergraduate majors in microbiology. Offered on a satisfactory-fail grading basis only.

Micro 475. Immunology. (Dual-listed with 575.) (3-0) Cr. 3. S. *Prereq:* *310.* An examination of humoral and cellular immune function as well as the interaction of the cells and factors of the immune system that result in health and disease. Credit for either 475 or 520, but not both, may be applied to graduation.

Micro 477. Bacterial-Plant Interactions. (Dual-listed with 577; same as PI P 477.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* *3 credits in microbiology or plant pathology.* Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interactions with plants.

Micro 485. Soil Microbial Ecology. (Same as Agron 485.) See *Agronomy*. Nonmajor graduate credit.

Micro 487. Aquatic and Wetland Microbial Ecology. (Dual-listed with 587; same as Bot 487.) See *Botany*.

Micro 490. Independent Study. Cr. 1 to 5. F.S.SS. *Prereq:* *A minimum of 6 credit hours of 300-level or above coursework in microbiology, permission of instructor.* A maximum of 6 credits of 490 may be used toward the total of 128 credits required for graduation. Materials fee.
H. Honors

Micro 495. Internship. Cr. 1 to 2. F.S. *Prereq:* *At least 6 credits of 300-level or above coursework in microbiology, approval of academic adviser.* Participation in the Cooperative Extension Intern Program or an equivalent work experience. Written report of activities required. Offered on a satisfactory-fail grading basis only.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Micro 501. Advanced Microbiology. (3-0) Cr. 3. F. SS. *Prereq:* *Biol 202, 6 credits of chemistry.* Overview of microbiology and introduction to the literature. Topics include prokaryote structure and function, physiology, genetics, virology and immunology. Credit for 302 or 501, but not both, may be applied toward graduation.

Micro 502. Microbial Genetics. (Dual-listed with 402; same as MCDB 502.) (3-1) Cr. 3. F. *Prereq:* *320.* Microbial and bacteriophage genetics; emphasis on mutagenesis, mechanisms of genetic exchange, genetic analysis of cellular mechanisms, and an introduction to genetic engineering.

Micro 504. Microbial Physiology. (Dual-listed with 404.) (3-0) Cr. 3. S. *Prereq:* *320.* Topics in microbial physiology, including structure and function of cell components, bioenergetics, diversity, life in extreme environments growth, adaptation and regulation.

Micro 507. Microbiological Safety of Foods of Animal Origins. (Dual-listed with 407; same as

FS HN 507.) (3-0) Cr. 3. S. *Prereq:* *420.* Examination of the various factors in the production of foods of animal origin, from animal production through processing, distribution and final consumption which contribute to the overall microbiological safety of the food. The two modules of this course will be 1) the procedures and processes which can affect the overall microbiological safety of the food, and 2) the Hazard Analysis Critical Control Point (HACCP) system.

Micro 508. Virology. (Dual-listed with 408.) (3-0) Cr. 3. F. *Prereq:* *310.* The biology of animal, plant, and insect viruses.

Micro 509. Plant Virology. (Same as PI P 509.) See *Plant Pathology*.

Micro 525. Food Biotechnology. (Dual-listed with 425; same as FS HN 525.) See *Food Science and Human Nutrition*.

Micro 526. Advanced Animal Virology. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* *387 or 408 or 508.* General and molecular pathogenesis and ecology of viral infections and procedures to diagnose and control viral infections.

Micro 540. Livestock Immunogenetics. (Same as An S 540.) See *Animal Science*.

Micro 575. Immunology. (Dual-listed with 475.) (3-0) Cr. 3. S. *Prereq:* *310.* Humoral and cellular immune functions. Interactions between cells and factors of the immune system that result in health and disease. Credit for either 575 or 520, but not both, may be applied toward graduation.

Micro 577. Bacterial-Plant Interactions. (Dual-listed with 477; same as PI P 577.) (3-1) Cr. 3. Alt. S., offered 2000. *Prereq:* *3 credits in microbiology or plant pathology.* Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interactions with plants.

Micro 585. Soil Microbiology and Biochemistry. (Same as Agron 585.) See *Agronomy*.

Micro 586. Medical Bacteriology. (Same as V MPM 586) (4-0) Cr. 4. F. *Prereq:* *310.* Bacteria associated with diseases of vertebrates, including virulence factors and interaction of host responses.

Micro 587. Aquatic and Wetland Microbial Ecology. (Dual-listed with 487; same as Bot 587.) See *Botany*.

Micro 590. Special Topics. Cr. 1 to 5 each time elected. F.S.SS. *Prereq:* *Permission of instructor.*

Micro 599. Creative Component. Cr. arr. *Prereq:* *Nonthesis M.S. Option only.* A written report based on laboratory research, library reading, or topics related to the student's area of specialization and approved by the student's advisory committee.

- A. Microbiology.
- B. Immunology.
- C. Virology.
- D. Preventive Medicine

Courses for Graduate Students

Micro 604. Seminar. (1-0) Cr. 1 each time taken. F.S. Offered on a satisfactory-fail grading basis only.

Micro 610. Microbiology of the Digestive Tract. (Same as An S 610) See *Animal Science*.

Micro 615. Molecular Immunology. (Same as BBMB 615.) See *Biochemistry, Biophysics, and Molecular Biology*.

Micro 620. Advanced Molecular Genetics. (Same as Gen 620.) See *Genetics*.

Micro 625. Mechanisms of Bacterial Pathogenesis. (Same as V MPM 625.) (4-0) Cr. 4. Alt. S., offered 2001. *Prereq:* *386 and 520.* Advanced study on virulence mechanisms of bacteria and current knowledge of research on host defenses in the pathogenesis of bacterial infections.

Micro 626. Advanced Food Microbiology. (Same as FS HN 626.) See *Food Science and Human Nutrition*.

Micro 641. General Mycology. (Same as Bot 641.) See *Botany*.

Micro 642. General Mycology. (Same as Bot 642.) See *Botany*.

Micro 679. Light Microscopy. (Same as Bot 679.) See *Botany*.

Micro 679L. Light Microscopy Laboratory. (Same as Bot 679L.) See *Botany*.

Micro 680. Scanning Electron Microscopy. (Same as Bot 680.) See *Botany*.

Micro 680L. Scanning Electron Microscopy Laboratory. (Same as Bot 680L.) See *Botany*.

Micro 681. Transmission Electron Microscopy. (Same as Bot 681.) See *Botany*.

Micro 681L. Transmission Electron Microscopy Laboratory. (Same as Bot 681L.) See *Botany*.

Micro 685. Advanced Soil Biochemistry. (Same as Agron 685.) See *Agronomy*.

Micro 690. Current Topics. Cr. 1 to 3 each time elected. F.S.SS. *Prereq: Permission of instructor.* Colloquia or advanced study of specific topics in a specialized field.

- A. Microbiology
- B. Immunology
- C. Infectious Diseases

Micro 698. Seminar in Molecular, Cellular, and Developmental Biology. (Same as MCDB 698.) See *Molecular, Cellular, and Developmental Biology*.

Micro 699. Research.

Courses offered at the Gulf Coast Research Laboratory (GCRL), Ocean Springs, Mississippi

The Gulf Coast Research Laboratory is affiliated with the University of Southern Mississippi. Iowa State students may register for the following University of Southern Mississippi/GCRL courses and transfer them to their ISU degree programs. Written permission of the ISU coordinator for the GCRL, 201 Bessey, is required for this arrangement. Inquire at 201 Bessey for further information.

MAR 409. Marine Microbiology. Cr. 3. SS. Offered for undergraduate credit through a cooperative arrangement with Iowa State University. *Prereq: 8 semester credits in microbiology.* A general course designed to introduce the microbiology and advanced biology student to the role of microorganisms in the overall ecology of the oceans and estuaries.

MAR 409L. Marine Microbiology Laboratory. Cr. 2. SS. Accompanies 409.

Military Science

Thomas W. Johnson, Chair of Department
Professors: Johnson

Instructors (Adjunct): Davey, Gunhus, Henderson, Snyder, Techau

The mission of the Reserve Officer Training Corps (ROTC) is to commission the future leaders of the United States Army. Since ROTC produces 65 percent of the Army's Officer Corps, our task is one of the most important undertakings in the Army and our country today. We seek top quality college students. We train these potential leaders, assess their abilities, and challenge them with the highest standards of profession/professionalism. Those who successfully complete the program, receive a commission as a second lieutenant in the U.S. Army. A commission as an Army officer affords the opportunity to pursue a profession in one or several of the

300 different jobs held by Army officers. Students may request to serve as an officer in either the active army, or part time in the Army Reserve or National Guard. Regardless of the method of service, officers in today's Army can be proud to know that they are doing their share in the defense of the United States of America.

The ISU military science program is divided into two segments, the basic program and the advanced program. The basic program (courses numbered 101-210) is designed primarily for freshmen and sophomores. **No military obligation** is incurred by a person participating in the basic program. The basic program is designed to be informative and to acquaint students with the military as a profession. The basic program or an allowed substitute is a prerequisite for the advanced program.

Financial assistance is available on a competitive basis.

Persons interested in military science should visit the department located upstairs in the Armory.

Basic Program

These courses are primarily for freshman and sophomore students and, except for veterans and basic training graduates, are required for entry into the advanced program. No more than 10 credits in 100- and 200-level courses may be applied toward graduation. The curriculum is designed to train freshmen and sophomores in individual and team skills. It also helps the Professor of Military Science identify individual leader developmental needs.

Advanced Program

These courses are for students who have completed the basic program (or received equivalent credit) and are mandatory for potential commissioning. These courses are primarily taught to juniors and seniors. Successful completion normally obligates the student to military service on active or reserve duty. In addition to the advanced program of study, a student (cadet) will be expected to pass the Army Physical Fitness Test (precondition for commissioning) each semester and continually maintain military appearance standards in both personal grooming and uniform. Physical fitness training is regularly conducted outside of class or laboratory hours. Students are expected to attend and participate in these exercise activities.

Professional Military Education (PME) coursework outside of the military science curriculum is also a precondition to commissioning. The PME component consists of two parts: completion of a bachelors degree and demonstrated proficiency in three areas: American Military History, Computer Literacy, and Communication. These standards are explained to prospective students as they consider enrollment in the advanced program. Uniforms will be worn at least twice weekly. The 300-level courses will prepare cadets for advanced camp, which is a five-week summer internship/training program where cadets are trained to Army standards, develop leadership skills, and have their officer potential evaluated. The 400-level courses are the final preparation for commissioning as a second lieu-

tenant in the U.S. Army. Students must meet academic alignment criteria and receive basic program credit before entering the advanced program.

Courses Primarily for Undergraduate Students

Basic Program

M S 101. Introduction to Military Science. (1-0) Cr. 1. F.SS. This course offers an overview of the role of the United States Army officer, the U.S. Army organization, and the Army ROTC program of instruction. Students will learn about the various jobs that an officer may assume, officer traditions, differences in officer and enlisted rank, and etiquette. Also, students will be provided instruction on college scholarships (Army ROTC and others), in confidence building (hands-on rappelling and marksmanship classes), leadership abilities, and professional knowledge about general military topics.

M S 101L. Basic Leadership Laboratory. (0-2) Cr. 0.5. F. This Lab is designed to use basic military training skills and tasks to develop confidence, character, and leadership in students. The team approach, combined with hands-on instruction, is the teaching methodology for the Lab. Students will learn various military tasks such as marching, rifle/pistol firing, and tactical patrolling; gain confidence by rappelling and serving in leadership positions over other students; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge, Pammel Woods (ISU campus), and ISU fitness centers (Beyer Gym and Rec Center). Full participation in all events will be determined based on students' physical and medical eligibility.

M S 102. The United States Defense Establishment. (1-0) Cr. 1. S.SS. This course instructs students on the U.S. Army's Principles of Warfighting. Students will gain an understanding of the applied skills, proven successful, required to defeat an opponent: militarily, athletically, or in the business world. Historical battles and significant military leaders will be analyzed to highlight dimensions of leadership that can be quantifiably assessed. Instruction will include programs to teach students the methodology used in ROTC to assess the leadership skills of both others and of self. Additional instruction will include time-management, decision-making, counseling, rappelling, marksmanship, and confidence-building tasks.

M S 102L. Basic Leadership Laboratory. (0-2) Cr. 1. S.SS. This Lab is designed to use basic military training skills and tasks to develop confidence, character, and leadership in students. The team approach, combined with hands-on instruction, is the teaching methodology for the Lab. Students will learn various military tasks such as marching, rifle/pistol firing, and tactical patrolling; gain confidence by rappelling and serving in leadership positions over other students; and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge, Pammel Woods (ISU campus), and ISU fitness centers (Beyer Gym and Rec Center). Full participation in all events will be determined based on students' physical and medical eligibility.

M S 201. Principles of Leadership. (2-0) Cr. 2. F.SS. Development of leadership skills by study of principles and traits of leadership: time management, values, decision making, communicating, delegating, and counseling. Leadership assessment programs, role playing, skits, and films are used to enhance and reinforce the instruction.

M S 201L. Basic Leadership Laboratory. (0-2) Cr. 1. F.SS. This Lab is designed to use basic military training skills and tasks to develop confidence, character, and leadership in students. The team approach, combined with hands-on instruction, is the teaching methodology for the Lab. Students will learn various military tasks such as marching, rifle/pistol firing, and tactical patrolling; gain confidence by rappelling and serving in leadership positions over other students;

and increase professional knowledge in areas such as first aid, water survival, personal physical fitness, and land navigation. Teaching locations include the ISU Armory, Camp Dodge, Pammel Woods (ISU campus), and ISU fitness centers (Beyer Gym and Rec Center). Full participation in all events will be determined based on students' physical and medical eligibility.

M S 202. Map Reading and Land Navigation. (2-0) Cr. 2. S.S. Characteristics and features of the earth's land mass and application of methods of conducting navigation on land by use of topographical maps, compasses, and aerial photographs, military map symbols and their practical application.

M S 202L. Basic Leadership Laboratory. (0-2) Cr. 1. S.SS. Basic military training related to developing confidence, character, and leadership. The team approach in task and mission accomplishment is taught with specific emphasis on land navigation and orienteering. Locations include Camp Dodge, Holst State Forest, Pammel Woods, and the ISU Armory. Certification of medical eligibility required for full participation.

M S 210. Practicum in Basic Military Skills. Cr. 6. SS. *Prereq: Permission of the professor of military science.* Basic military skills for students with no prior military or ROTC training. Involves attendance at the six-week Army ROTC Basic Camp, Fort Knox, Kentucky. Completion enables students to enroll in the Advanced Course and is taken in lieu of 101, 102, 201, and 202. Offered on a satisfactory-fail grading basis only.

Advanced Program

M S 301. Methods of Instructing Military Skills. (3-0) Cr. 3. F.S. *Prereq: Completion of the basic program.* Development of military writing techniques, basic educational psychology, oral presentation; skills, use of training aids, and lesson planning. Students prepare presentations incorporating all phases of instruction. Students engage in a series of practical opportunities to lead small groups. Additionally, the student is introduced to the Leadership Assessment Program and the Army Physical Fitness Program. The traditions and customs of the Army, as well as land navigation skills are reviewed.

M S 301L. Advanced Leadership Laboratory. (0-4) Cr. 1. F.S. *Prereq: Completion of the basic program.* On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs. The swim test, Army Physical Fitness Test and the diagnostic map test required of candidates for a commission.

M S 302. Small Unit Tactics. (3-0) Cr. 3. F.S. *Prereq: Completion of the basic program.* Organization, composition, and missions of operational elements. Principles of offensive and defensive combat operations with emphasis on the attack, retrograde, patrolling, combat intelligence, tactical orders, troop leading procedures, and combat leadership.

M S 302L. Advanced Leadership Laboratory. (0-4) Cr. 1. F.S. *Prereq: Completion of the basic program.* On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs. The swim test, Army Physical Fitness Test and the diagnostic map test required of candidates for a commission.

M S 310. Field Training Exercise. (0-3) Cr. 1. S. *Prereq: Completion of the basic program.* An annual military exercise that requires approximately 30 hours of planning, participation, and follow-up plus ROTC cadre evaluation. Designed primarily for the advanced ROTC cadets in preparation for being commissioned as officers in the U.S. Army. Actual military conditions are simulated: detailed instruction in weapons training and execution of a simulated Operation Order in accomplishing a specific military mission. Conducted as a weekend exercise at Camp Dodge. Offered on a satisfactory-fail grading basis only.

M S 401. The Military Team. (3-0) Cr. 3. F.S. *Prereq: Completion of the basic program.* Organization and operational concepts of the military staff, military units, administration, logistics and organizational structures within the Army division. Combat operations and their various elements, with emphasis on planning and coordination; and an introduction to military justice.

M S 401L. Advanced Leadership Laboratory. (0-4) Cr. 1. F.S. *Prereq: Completion of the basic program.* On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs.

M S 402. Seminar: The Professional Officer. (3-0) Cr. 3. F.S. *Prereq: Completion of the basic program.* Management, leadership, and professionalism; management tools, practices, theories, and principles; leadership principles, traits, and application.

M S 402L. Advanced Leadership Laboratory. (0-4) Cr. 1. F.S. *Prereq: Completion of the basic program.* On-the-job training and evaluation provided by the ROTC cadre. Developing training programs, structuring laboratories, presenting classes, planning various events, and accepting responsibility for the leadership labs.

M S 410. Field Training Exercise. (0-3) Cr. 1. S. *Prereq: Completion of the basic program.* An annual military exercise that requires approximately 30 hours of planning, participation, and follow-up plus ROTC cadre evaluation. Designed primarily for the advanced ROTC cadets in preparation for being commissioned as officers in the U.S. Army. Actual military conditions are simulated: detailed instruction in weapons training and execution of a simulated Operation Order in accomplishing a specific military mission. Conducted as a weekend exercise at Camp Dodge. Offered on a satisfactory-fail grading basis only.

M S 490. Independent Study. (1-0) Cr. 1 each time taken. *Prereq: 402 and permission of the professor of military science.* Investigation of an approved topic. Must result in a professional journal-worthy paper on ethics, current military issues, interpersonal communications, or leadership development.

Molecular, Cellular, and Developmental Biology

(Interdepartmental Graduate Major)

Program Executive Officer: Jorgen Johansen

Participating Faculty: Jorgen Johansen, Chair; L. Ambrosio, I. L. Anderson, A. Androcotti, R. E. Andrews, A. G. Atherly, G. Beattie, P. Becraft, D. C. Beitz, D. Birt, S. H. Bishop, B. Bonning, J. Buss, S. Carpenter, P. Chitnis, C. Coffman, T. Colbert, D. Dobbs, C. F. Ford, D. J. Graves, R. Hamilton, D. Hannapel, P. G. Haydon, E. R. Henderson, J. Horowitz, T. S. Ingebritsen, J. Johansen, K. M. Johansen, M. Lee, C. Link, J. E. Mayfield, M.A. McCloskey, W. J. Miller, F. C. Minion, A. M. Myers, B. J. Nikolau, M. Nilsen-Hamilton, D. Oliver, J. A. Olson, G. Phillips, R. M. Robson, S. R. Rodermel, R. F. Rosenbusch, D. S. Sakaguchi, P. S. Schnable, S. S. Shen, M. H. Spalding, M. H. Stromer, M. J. Taylor, R. W. Thornburg, C. K. Tuggle, D. F. Voytas, E. S. Wurtele

Undergraduate Study

A special program in molecular, cellular, and developmental biology is not offered for the baccalaureate. Undergraduates wishing to prepare for graduate study in molecular, cellular, and developmental biology should elect courses in biochemistry, botany, genetics, microbiology, and zoology; mathematics through calculus; chemistry through organic; and one year of physics. Biol 301, 301L, 302, and 302L are recommended to undergraduates desiring an introduction to this area.

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in molecular, cellular, and developmental biology in several cooperating departments: Agronomy; Animal Science; Biochemistry, Biophysics & Molecular Biology; Biomedical Sciences; Botany; Food Science and Human Nutrition; Microbiology; Plant Pathology; Veterinary Microbiology & Prevention Medicine; and Zoology and Genetics.

Facilities and qualified faculty are available in these departments for conducting fundamental research in the various aspects of molecular, cellular, and developmental biology. Ongoing research projects include molecular and cellular studies of viral, prokaryotic, plant, and animal systems.

Students may enter the MCDB major in one of two ways: they may apply to and be accepted into the major directly or they may formally apply to the major after being accepted by a participating department. Students admitted into MCDB will take MCDB 697 in their first two semesters and choose a major professor from the participating faculty and a department by the end of their second semester. Students admitted by a department will choose a major professor from the participating faculty in that department. All Ph.D. students take a core curriculum consisting of the following courses: one year of biochemistry (BBMB 404, 405 or BBMB 501, 502), molecular genetics (MCDB 502, 511, 545, or 676), cell biology (MCDB 528 or 529 or 540), developmental biology (MCDB 512, 533, or 630), and seminar in MCDB (MCDB 698). In seminar, students will make journal and research presentations and attend MCDB faculty seminars. M.S. students take the above core but may delete either the molecular genetics, cell biology, or developmental biology component. Additional coursework is selected to meet departmental requirements and to satisfy individual student research interests; courses may be chosen from those listed below. The foreign language requirement is determined by the student's major department. All graduate students are required to teach as part of their training for an advanced degree.

Students minoring in molecular, cellular, and developmental biology at the Ph.D. level must meet the following requirements: one year of biochemistry (BBMB 404, 405, or BBMB 501, 502; one course in each of two of the following three areas: molecular genetics (MCDB 502, 511, 545, or 676), cell biology (MCDB 528 or 529 or 540), developmental biology

(MCDB 512, 533, or 630); and enrollment in MCDB 698 (seminar in MCDB) each year.

Courses for Graduate Students

MCDB 502. Microbial Genetics. (Same as Micro 502.) See *Microbiology*.

MCDB 511. Molecular Genetics. (Same as Gen 511.) See *Zoology and Genetics*.

MCDB 512. Plant Growth Regulation. (Same as Bot 512.) See *Botany*.

MCDB 520. Genetic Engineering. (Same as Gen 520.) See *Zoology and Genetics*.

MCDB 528. Cellular Growth and Regulation. (Same as Zool 528.) See *Zoology and Genetics*.

MCDB 529. Plant Cell Biology. (Same as Bot 529.) See *Botany*.

MCDB 533. Developmental Biology. (Same as Zool 533.) See *Zoology and Genetics*.

MCDB 540. Signal Transduction. (Same as Zool 540.) See *Zoology and Genetics*.

MCDB 545. Plant Molecular Biology. (Same as Bot 545.) See *Botany*.

MCDB 590. Special Topics. Cr. arr.

MCDB 630. Developmental Genetics. (Same as Gen 630.) See *Zoology and Genetics*.

MCDB 676. Biochemistry of Gene Expression in Eucaryotes. (Same as BBMB 676.) See *Biochemistry, Biophysics and Molecular Biology*.

MCDB 697. Graduate Research Rotation. (0-3 to 0-18) Cr. 1 to 6 each time taken. F.S. Graduate research projects performed under the supervision of selected faculty members in the molecular, cellular, and developmental biology program.

MCDB 698. Seminar in Molecular, Cellular, and Developmental Biology. (Same as An S 698, BBMB 698, Bot 698E, Gen 698, Micro 698, V MPM 698, Zool 698.) (2-0) Cr. 1 to 2 each time taken. F.S. Student and faculty presentations.

MCDB 699. Research.

Music

Sue E. Haug, Head of Department

Professors: Bleyle, Darlington, David, Messenger, Molison, Prater, Work, Zeigler

Distinguished Professors (Emeritus): White

Professors (Emeritus): Brandt, Burkhalter, Swift, Vongrabov

Associate Professors: Alcorn, Cox, Gouran, Haug, Henry, Schilling, Simonson, Stuart, Szabo

Associate Professors (Collaborators): Sturm

Associate Professors (Emeritus): Bjurstrom

Assistant Professors: Baker, Bovinette, Dunlap, Fowler, Larkin, Munsen, Province, Sadilek, Sanda, Tam, Trenberth, Weston

Assistant Professors (Adjunct): Flakerud, Seebeck

Assistant Professors (Emeritus): Waggoner

Instructors (Adjunct): Thomas

Instructors (Collaborators): Foss, Kaizer, Tener, Vallier

Undergraduate Study

The Department of Music is committed to a philosophy of education that draws its goals from the larger purposes of liberal arts educa-

tion and from the guidelines of its accrediting agency, the National Association of Schools of Music (NASM). The primary aims of the department are to prepare students for a variety of professions in music, to provide all students with educational experiences that will enhance their understanding of and aesthetic sensitivity to music, and to serve as a vital force in the cultural life of the university, the community, and throughout the state and nation.

The teaching mission of the department is two-fold. It provides: (1) a comprehensive program of professional studies for students who wish to prepare for careers in music, including teaching, performance, and composition, and for students who plan to pursue graduate studies in music, and (2) courses in music literature, theory and areas of performance for all students, regardless of major.

It is the department's mission to serve as an exemplar of the spirit and quality of a major university which strives to produce truly educated and well-rounded graduates.

The Department of Music is an accredited institutional member of the National Association of Schools of Music.

The Theatre Program is administered by the Department of Music (see *Index, Theatre Courses*.)

Bachelor of Music

For the undergraduate curriculum in music, leading to the degree bachelor of music, see *Liberal Arts and Sciences, Curriculum*. In order to receive teacher certification in music, students must earn the Bachelor of Music degree.

Candidates for the bachelor of music will complete the following requirements.

Cr.	
46	General education
0.5	Library
46	Music core

34-35 Music major (Students must select one of the following options: music education, organ, piano, string instruments, composition, voice, and wind or percussion instruments.)

Bachelor of Arts—Music Major

For the undergraduate curriculum in Liberal Arts and Sciences, major in music, leading to the degree bachelor of arts, see *Liberal Arts and Sciences, Curriculum*.

Candidates for the degree bachelor of arts with a music major will normally complete 48 credits including the following required courses: 119, 120, 219, 233, 234, 235, 236, 319, 333, 334, 335, 336, 383, 384.

Bachelor of arts students whose chief professional interest lies in research are encouraged to minor in foreign languages and literatures, history, literature, or philosophy.

Minor in Music. Candidates for the minor in music will complete 19 credits in music, including 6 credits in courses numbered 300 and above taken at ISU with a grade of C or better, and

- one of the following: 100 or 233 and 234;
- one of the following: 102, 103, 104, 120;
- either

Two consecutive semesters of one of the following: 111, 112, 113, 131, 141, 151, 161, 171, 181, 301

or

Two consecutive semesters of one applied music area (choose from 118, 318; 127, 128, 227, 228, 327 or 133).

General Requirements

Audition and Placement Requirements. To be accepted as a music major, the student must demonstrate an appropriate level of performance as well as potential in one of the following performing media: piano, organ, woodwinds, strings, percussion, brass, or voice. In addition, a student must satisfactorily complete placement examinations in music theory and keyboard skills, which will be administered to all applicants. The placement examinations will be given by members of the departmental faculty during summer orientation, the week preceding the opening of classes for fall semester, or by appointment.

Students should request these examinations from the Department of Music office before deciding on a major in music.

Seminars and Recitals. All music majors enrolled for applied music courses will attend a weekly 1-hour seminar in their areas and departmental recitals each semester.

Ensemble Requirement. All bachelor of music students must register for one ensemble course every semester of residence (except during student teaching). Two semesters must be in a large ensemble; six semesters in a large ensemble for music education majors. See the *Music Department Student Handbook* for further information.

Continuation Examination. To be approved for continuation as a music major on the junior level, a student must pass a continuation examination taken normally at the end of the fourth semester. Before taking this examination, the student must fill out the requisite forms as well as prepare a statement of (1) his/her personal goals, (2) a self-assessment of his/her progress thus far, and (3) an assessment of what he/she expects to accomplish before graduation.

The Continuation Examination is divided into two parts. Part A consists of performance before a Continuation Examination Committee. Requirements include the performance of three works representing different periods or styles selected by and studied with the applied teacher, a self-prepared piece, and sight reading. During this part of the examination the student must display acceptable solo ability and performance techniques in at least one of the applied areas. A written evaluation will be given each student following his/her performance. Following the successful completion of Part A, the student will meet with the jury committee and adviser to receive a candid assessment of the student's potential to achieve his/her goals (Part B).

All music majors must demonstrate proficiency in piano as a part of the continuation examination. Proficiency will normally be demonstrated by completing Music 228 or, for keyboard majors, by completing Music 219 or 327. The student must pass all parts of the continuation examination in order to enroll for Music 319 or 419, Applied Music. See the *Music Department Student Handbook* for further information.

Graduation Proficiency. To be recommended for graduation, a music student should demonstrate to the music faculty mature acquaintance with performance styles, technique, and repertoire. All music majors will participate in departmental recitals to the satisfaction of the department. Candidates for the bachelor of music degree will present a graduation recital.

English proficiency requirement: The department requires a grade of C- or better in each of Engl 104 and 105 (or 105H), and completion of Music 383 or 384 to the department's satisfaction; or Engl 302, or 305, or 314 with a grade of C- or better.

Graduate Study

Courses open for nonmajor graduate credit: 430, 440, 472, 473, 474, 475, 476.

Courses Primarily for Undergraduate Students

Music 100. Fundamentals of Music. (1-2) Cr. 2. F.S. *Prereq:* Ability to read elementary musical notation. Notation, recognition, execution and analysis of scales, intervals, triads, and rhythm; key signatures; time signatures; transposition. Intended for non-majors.

Music 102. Introduction to Music Literature I. (3-0) Cr. 3. F.S.SS. Expansion of the music listening experiences of the general student through greater awareness of differences in techniques of listening, performance media, and materials of the art. The course focuses on the elements of music: rhythm, melody, harmony, form, and style, and how these elements are used in musics of different cultures and time periods. Student need not be able to perform or read music. Open to non-majors only.

Music 103. Introduction to Music Literature II. (3-0) Cr. 3. S. *Prereq:* Music 102. Continuation of music listening experiences of the general student through directed listening and discussion-analysis. Study of instrumental and vocal compositions for solo, chamber, and large ensemble media. Emphasis on stylistic differences among composers and musical periods, Western and non-Western. Student need not be able to perform or read music. Open to non-majors only.

Music 104. History of Rock "n" Roll. (3-0) Cr. 3. S. *Prereq:* 100 or 102 or 233. Rock "n" Roll from the mid 1950s through the 1990s, focusing on the development of rock styles from its roots in blues, folk, country, and pop. Expansion of listening experience through study of song forms, instrumentation, and the socio-political significance of song lyrics. Student need not be able to perform or read music.

Music 111. Wind Ensemble. (0-3) Cr. 1 each time taken. F.S. *Prereq:* Open to all students by audition. Emphasis on significant extended compositions for wind and percussion instruments. Performances include formal concerts on campus and the annual tour. Offered on a satisfactory-fail grading basis only.

Music 112. University Band. (0-2) Cr. 1 each time taken. S. *Prereq:* Open to all students who have performed on a wind or percussion instrument in high school band or orchestra. Repertoire includes the broad spectrum of band music. Two concerts are presented each spring. Offered on a satisfactory-fail grading basis only.

Music 113. Jazz Ensemble. (0-2) Cr. 1 each time taken. F.S. *Prereq:* Open to all students by audition. Designed to explore various styles and trends in contemporary jazz. Offered on a satisfactory-fail grading basis only.

Music 114. Marching and Pep Bands. (0-5) Cr. 1 each time taken.

A. Marching Band. F. *Prereq:* Open to all students who have performed on a wind or percussion instrument in high school band or orchestra. Membership determined by date of band application; audition required for percussion, flags, and twirlers. Presentation of pre-game and half time shows at each home and at least one away football game. Offered on a satisfactory-fail grading basis only.

B. Pep Band. S. *Prereq:* 114A and permission of instructor. Performances at basketball games. Offered on a satisfactory-fail grading basis only.

Music 115. Symphonic Band. (0-3) Cr. 1 each time taken. F.S. *Prereq:* Open to all students by audition. Stresses high quality wind literature. Performances include formal concerts on campus. Offered on a satisfactory-fail grading basis only.

Music 118. Applied Music: Non-majors. (.5-0 or 1-0) Cr. 1 or 2 each time taken. F.S.SS. *Prereq:* Audition, permission of instructor. Applied music for the general student. Will not satisfy applied music requirements for music majors. Fee.

- A. Voice
- B. Piano
- C. Organ
- D. Strings
- E. Carillon
- F. Woodwinds
- G. Brass
- I. Percussion
- K. Harpsichord

Music 119. Applied Music: Majors. (.5-2 or 1-2) Cr. 1 to 3 each time taken. F.S.SS. *Prereq:* Audition, permission of instructor; restricted to music majors. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required. Fee.

- A. Voice
- B. Piano
- C. Organ
- D. Strings
- E. Carillon
- F. Woodwinds
- G. Brass
- I. Percussion
- K. Harpsichord

Music 120. Introduction to Music Listening. (3-0) Cr. 3. S. *Prereq:* Music major classification. Directed studies via aural analysis for music majors with emphasis on the materials of music, form and aesthetic issues. Introduction to style and literature of the major performance media in context of historical chronology. Fundamentals of score reading and performance terminology.

Music 127. Class Study in Piano I. (0-2) Cr. 1. F. *Prereq:* 100 or audition, and permission of instructor. Beginning keyboard technique, repertoire, and sightreading skills.

Music 128. Class Study in Piano I. (0-2) Cr. 1. F. *Prereq:* 127 or audition, and permission of instructor. Continuation of beginning keyboard technique, repertoire, and sightreading skills.

Music 130. Introduction to Music Theory. (0-2) Cr. 1. F. *Prereq:* Music placement examination. Designed for students who are enrolled in Music 233 but who show a need for basic aural-perceptual skills as demonstrated by performance on a placement test. Intensive training in sight singing, ear training, and related aural skills.

Music 131. Vocal Jazz Ensemble. (0-2) Cr. 1 each time taken. F.S. *Prereq:* Open by audition and permission of instructor; concurrent enrollment in one of the following: 151, 161, 171. Small mixed chorus specializing in advanced vocal jazz techniques. Performances on and off campus. Offered on a satisfactory-fail grading basis only.

Music 133. Basic Voice Techniques. (0-2) Cr. 1 each time taken. F.S. *Prereq:* Permission of instructor. Class study in voice. Techniques of vocal produc-

tion: respiration, phonation, resonance, articulation, and performance.

Music 141. University Chorus. (0-3) Cr. 1 each time taken. F.S. *Prereq:* Open to all students by audition. Campus concerts each semester. Offered on a satisfactory-fail grading basis only.

Music 146. Summer Band. (0-2) Cr. .5 each time taken. SS. *Prereq:* Open to all students who have performed on a wind or percussion instrument in band or orchestra. One concert presented in SS. Offered on a satisfactory-fail grading basis only.

Music 151. Oratorio Chorus. (0-3) Cr. 1 each time taken. F.S. *Prereq:* Open to all students by audition. Campus concerts each semester, some concerts in conjunction with ISU Symphony. Offered on a satisfactory-fail grading basis only.

Music 156. Summer Chorus. (0-2) Cr. .5 each time taken. SS. Open to students, staff, and community. Offered on a satisfactory-fail grading basis only.

Music 161. Iowa State Singers. (0-5) Cr. 1 each time taken. F.S. *Prereq:* Open to all students by audition. Concert choir specializing in performance of advanced music literature, Renaissance through contemporary. Campus concerts, annual spring tour. Offered on a satisfactory-fail grading basis only.

Music 171. Chamber Singers. (0-3) Cr. 1 each time taken. F.S. *Prereq:* Open to all students by audition. Several appearances annually by a select group capable of advanced study, performing music literature appropriate for small vocal ensemble, Renaissance through contemporary. Offered on a satisfactory-fail grading basis only.

Music 181. Symphony Orchestra. (0-4) Cr. 1 each time taken. F.S. *Prereq:* Open to all students by audition. Reading, preparation, and performance of standard repertoire. Five or six concerts annually plus occasional off-campus appearances. Offered on a satisfactory-fail grading basis only.

Music 219. Applied Music: Majors. (.5-2 or 1-2) Cr. 1 to 3 each time taken. F.S.SS. *Prereq:* Audition, permission of instructor; restricted to music majors. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required. Fee.

- A. Voice
- B. Piano
- C. Organ
- D. Strings
- E. Carillon
- F. Woodwinds
- G. Brass
- I. Percussion
- K. Harpsichord

Music 227. Class Study in Piano II. (0-2) Cr. 1. F. *Prereq:* 128 or audition and permission of instructor. Intermediate keyboard technique, repertoire, and sightreading skills. Introduction to score reading, hymn playing, and accompanying at the piano.

Music 228. Class Study in Piano II. (0-2) Cr. 1. S. *Prereq:* 227 or audition and permission of instructor. Continuation of intermediate keyboard technique, repertoire, and sightreading skills. Introduction to score reading, hymn playing, and accompanying at the piano.

Music 233. Basic Materials of Music. (2-0) Cr. 2. *Prereq:* Placement examination. Review of fundamentals. Harmonic, melodic, and rhythmic materials of the common practice period. Application of these materials in analysis and writing. Techniques of harmonization and nonharmonic tones.

Music 234. Basic Aural Theory. (1-2) Cr. 2. *Prereq:* Placement examination. Development of sight singing, ear training, and keyboard skills with emphasis on harmonic, melodic, and rhythmic materials from the common practice period.

Music 235. Basic Materials of Music. (2-0) Cr. 2. *Prereq:* 233. Harmonic, melodic, and rhythmic materials of the common practice period. Application of these materials in analysis and writing. Techniques of harmonization and nonharmonic tones.

Music 236. Basic Aural Theory. (1-2) Cr. 2. *Prereq:* 234. Development of sight singing, ear training, and keyboard skills with emphasis on harmonic, melodic,

and rhythmic materials from the common practice period.

Music 248. Introduction to Music Technology. (2-1) Cr. 2. S. *Prereq:* 100 or 233. Introduction to the history and current use of technology in music education and the music industry. Hands-on work with MIDI/computer music software, recording studio equipment, including mixers, multitrack tape analog and digital synthesis, signal processing.

Music 265. Music in Elementary Education. (3-0) Cr. 3. F.S. *Prereq:* HD FS 226 or Psych 230. Experiencing and understanding the fundamentals of music through singing, playing classroom instruments, body movement, reading notation, listening, and creative activities. Developing lesson plan strategies and sequence, exploring multicultural musics, integrating music with other subjects in the elementary classroom, and evaluating aspects of musical learning.

Music 266. Introduction to Music Education. (1-2) Cr. 2. F. *Prereq:* Concurrent enrollment (1 cr.) in LAS 480K. Required for second-year majors in music education. Historical, philosophical, and social foundations of music education; music curricula overview including goals of the music program, and contemporary and international curriculum development; psychology of teaching music including discipline techniques. Preparation for required observations in area schools.

Music 290. Special Problems. Cr. var. F.S.SS. *Prereq:* Permission of instructor; A through F: 12 credits in music, approval of department head: H: approval of department head.

- A. Education
- B. Theory
- C. Composition
- D. History
- E. Literature
- F. Applied Music
- H. Honors

Music 301. Opera Studio. Cr. 1 to 3 each time taken. F.S. *Prereq:* Permission of instructor. Study of selected opera scenes and chamber operas. Basic stagecraft, role interpretation, production.

Music 318. Applied Music: Non-majors. (.5-0 or 1-0) Cr. 1 or 2 each time taken. F.S.SS. *Prereq:* Audition, permission of instructor. Applied music for the general student. Will not satisfy applied music requirements for music majors. Materials fee.

- A. Voice
- B. Piano
- C. Organ
- D. Strings
- E. Carillon
- F. Woodwinds
- G. Brass
- I. Percussion
- K. Harpsichord

Music 319. Applied Music: Majors. (.5-2 or 1-2) Cr. 1 to 3 each time taken. F.S.SS. *Prereq:* Audition, permission of instructor; restricted to music majors. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required. Materials fee.

- A. Voice
- B. Piano
- C. Organ
- D. Strings
- E. Carillon
- F. Woodwinds
- G. Brass
- I. Percussion
- K. Harpsichord

Music 321. Advanced Ensemble. (0-3) Cr. 1 each time taken. F.S. *Prereq:* Advanced proficiency and performing ability, permission of director and department head. Performance in ensembles that demand high proficiency. Open to a limited number of undergraduate and graduate students.

- A. Voice
- B. Piano
- C. Organ
- D. Strings
- E. Musica Antiqua
- F. Woodwinds
- G. Brass

I. Percussion
J. Mixed

Music 324. English and Italian Diction for Singing. (2-0) Cr. 2. Alt. F., offered 2000. *Prereq:* Credit or enrollment in 118A or 119A. The international phonetic alphabet and its application to correct pronunciation of English and Italian in singing.

Music 325. French and German Diction for Singing. (2-0) Cr. 2. Alt. S., offered 2001. *Prereq:* Credit or enrollment in 118A or 119A. The international phonetic alphabet and its application to correct pronunciation of French and German in singing.

Music 327. Functional Piano. (0-3) Cr. 2. S. *Prereq:* 228 or audition and permission of instructor. Emphasis on sight reading, three- and four-part score reading, improvisation, accompanying, and advanced harmonization.

Music 333. Advanced Materials of Music. (2-0) Cr. 2. *Prereq:* 235. Writing and analysis based on musical styles from the Renaissance through the early 19th century.

Music 334. Advanced Aural Theory. (1-2) Cr. 2. *Prereq:* 236. Development of sight singing, ear training, and keyboard skills with emphasis on harmonic, melodic, and rhythmic materials from the 18th and 19th centuries.

Music 335. Advanced Materials of Music. (2-0) Cr. 2. *Prereq:* 333. Writing and analysis based on musical styles from the 19th and 20th century.

Music 336. Advanced Aural Theory. (1-2) Cr. 2. *Prereq:* 334. Development of sight singing, ear training, and keyboard skills with emphasis on harmonic, melodic, and rhythmic materials from the 19th and 20th centuries.

Music 350. Instrumental Techniques: Strings. (0-2) Cr. 1. F. *Prereq:* Concurrent enrollment in 358B. Techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental music specialist.

Music 351. Instrumental Techniques: Clarinet, Flute, Saxophone. (1-2) Cr. 2. S. *Prereq:* Concurrent enrollment in 358B. Techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental music specialist.

Music 352. Instrumental Techniques: Oboe, Bassoon. (0-2) Cr. 1. F. *Prereq:* Concurrent enrollment in 358B. Techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental music specialist.

Music 353. Instrumental Techniques: Trumpet, French Horn. (0-2) Cr. 1. S. *Prereq:* Concurrent enrollment in 358B. Techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental music specialist.

Music 354. Instrumental Techniques: Trombone, Baritone, Tuba. (0-2) Cr. 1. F. *Prereq:* Concurrent enrollment in 358B. Techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental music specialist.

Music 355. Instrumental Techniques: Percussion. (0-2) Cr. 1. S. *Prereq:* Concurrent enrollment in 358B. Techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental music specialist.

Music 356. Instrument Maintenance and Repair. (0-2) Cr. 1. F. *Prereq:* Permission of instructor. Techniques and skills required for basic maintenance and repair of wind and percussion instruments. Examination of commercial repair methods and facilities. For the instrumental music specialist.

Music 358. Lab Ensemble. (0-1) Cr. R. Review and selection of appropriate literature for ensembles of differing levels and abilities; conducting and rehearsal experience.

A. Choral. Sight singing, conducting, and accompanying experience in conjunction with 362A. Required of all vocal music education majors in every semester offered.

B. Instrumental. F.S. Performance on secondary instruments. Required of all instrumental music education majors in those semesters when concurrently enrolled in 350, 351, 352, 353, 354, and 355.

Music 360. Vocal Pedagogy. (2-0) Cr. 2. S. *Prereq:* 319A or vocal proficiency examination. Physical, acoustical, and musical properties of the vocal instrument, including a survey of important texts and articles on singing and voice production.

Music 361. Conducting I. (1-2) Cr. 2. F. *Prereq:* 235, 236. Introduction to conducting; score reading and analysis. Conveying musical ideas through appropriate gestures. Leadership role of the conductor.

Music 362. Conducting II. (1-2) Cr. 2. S. *Prereq:* 361. A. Choral techniques. Score preparation, style and interpretation of choral repertoire. Concurrent enrollment in 358A.

B. Instrumental techniques. Advanced baton technique. Score preparation. Specific problems of large instrumental ensembles. Concurrent enrollment in 358B.

Music 364. Music in Early Childhood Education. (3-1) Cr. 3. S. *Prereq:* HD FS 226 or Psych 230. Objectives, teaching strategies, and materials for guiding musical growth in children ages 3 to 7. Identifying musical characteristics of children, establishing a musical environment, and the utilization of classroom instruments, folk songs, movement, and creative activities in conceptual teaching and learning. Observation of, and participation in, early childhood settings.

Music 366. Methods of Music Education. (2-0) Cr. 2. F. *Prereq:* Concurrent enrollment (1 cr.) in LAS 480K: 266 and admission into teacher education. Music education strategies and materials including development of appropriate objectives and plans for general music classes utilizing traditional and multicultural musics, evaluating musical learning; overview of Orff Schulwerk, Kodaly, and Dalcroze approaches; music in special education; required teaching in lab settings and observations in area schools.

Music 367. Vocal Jazz and Show Choir Techniques. (2-0) Cr. 2. S. *Prereq:* 361. Emphasis on developing and teaching vocal jazz and show choir programs in secondary schools; including aspects of style, review of literature, choreography, costuming, and use of technology.

Music 368. Marching Band and Jazz Ensemble Techniques. (2-0) Cr. 2. S. *Prereq:* Credit or enrollment in 362B. Techniques and materials for teaching marching band in the high school; philosophy, computer assisted drill design, music analysis, band set up, and other related skills. Jazz style, articulation, phrasing, materials and teaching techniques for secondary school jazz ensembles.

Music 369. String Pedagogy. (0-2) Cr. 1. S. *Prereq:* 319D or 350. Practical examination of current teaching methods and materials. Intended for string instrumental music education majors.

Music 381. Survey of Black American Music. (Same as Af Am 381.) (3-0) Cr. 3. S. *Prereq:* 100 or 102 or 120 or Thre 106. Historical introduction to African American Music, 1619-present. Attention will be given to the nature of African American musical cultures rather than to those examples which are readily represented by contemporary media. Ability to read music helpful but not necessary.

Music 383. History of Music. (3-0) Cr. 3. F. *Prereq:* 102 or 120. History of the stylistic and cultural development of music: Middle Ages through Baroque.

Music 384. History of Music. (3-0) Cr. 3. S. *Prereq:* 383 recommended. History of the stylistic and cultural development of music: Classical through contemporary music.

Music 417. Literature and Pedagogy in Applied Music. Cr. 1 to 3 each time taken. F.S.SS. *Prereq:* Permission of instructor.

- A. Voice
- B. Piano
- C. Organ
- D. Strings
- E. Carillon
- F. Woodwinds
- G. Brass
- I. Percussion
- J. Jazz Pedagogy and Performance

Music 419. Applied Music: Majors. (.5-2 or 1-2) Cr. 1 to 3 each time taken. F.S.SS. *Prereq: Audition, permission of instructor; restricted to music majors.* Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required. Materials fee.

- A. Voice
- B. Piano
- C. Organ
- D. Strings
- E. Carillon
- F. Woodwinds
- G. Brass
- I. Percussion
- K. Harpsichord

Music 430. Seminar in Analysis for Performance. (3-0) Cr. 3 each time taken. S. *Prereq: 335, 336.* Analysis and performance of selected works appropriate to student's performance medium. Examination of structural, rhythmic, harmonic, and textural aspects of the music selected. Literature will vary according to the needs of the class. Nonmajor graduate credit.

Music 440. Seminar in Music Theory. (3-0) Cr. 3 each time taken. F. *Prereq: 335, 336, or permission of instructor.* Various topics in music theory including counterpoint, arranging, pedagogy, and psychology of music. Content will vary. Contact the Department of Music for the current year offering. Nonmajor graduate credit.

Music 448. Electronic Music Synthesis. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: 248 for music majors; non-majors, permission of instructor.* Techniques of electronic music production, recording, mixing. Advanced computer applications including MIDI, digital synthesis in hardware and software, and digital signal processing. Emphasis on applications to music and creative work.

Music 464. Instrumental Administration, Materials, and Methods. (2-0) Cr. 2. S. *Prereq: Credit or enrollment in 362B.* Instructional materials and methods appropriate for teaching instrumental music in elementary, middle school, and high school music programs. Required observations in area schools.

Music 465. Choral Materials and Methods. (2-0) Cr. 2. F. *Prereq: Credit or enrollment in 466.* Instructional materials and methods appropriate for teaching choral music in the secondary school. Emphasis on pedagogy and rehearsal techniques. Required observations in area schools.

Music 466. Program Development and Evaluation in Music Education. (2-1) Cr. 2. F. *Prereq: 362, 366, successful completion of continuation exam.* Developing a rationale for music education; music program development; evaluation of music curricula, programs and facilities; professional growth of the teacher; preparation for student teaching and the job market. Required observations in area schools.

Music 472. History of American Music. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: 9 credits from music, American literature, American history, art history.* Serious and popular currents that have influenced development in American music and its relation to transcendentalism, mass culture, and other intellectual, social, and cultural trends in the history of America. Nonmajor graduate credit.

Music 473. Music of the Baroque Era. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: 383, 384.* Detailed survey of instrumental, vocal, choral, and keyboard music from 1600 to 1780. Nonmajor graduate credit.

Music 474. Music of the Classical Era. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: 383, 384.* Detailed survey of instrumental, vocal, choral, and keyboard music from 1780 to 1825. Nonmajor graduate credit.

Music 475. Music of the Romantic Era. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 383, 384.* Detailed survey of instrumental, vocal, choral, and keyboard music from 1825 to 1910. Nonmajor graduate credit.

Music 476. Music of the Twentieth Century. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: 383, 384.* Detailed survey of instrumental, vocal, choral, and keyboard music from 1900 to the present. Nonmajor graduate credit.

Music 490. Independent Study. Cr. var. F.S.SS. *Prereq: Permission of instructor; A through F: 12 credits in music, approval of department head. No more than 9 credits of Music 490 may be counted toward graduation*

- A. Education
- B. Theory
- C. Composition
- D. History
- E. Literature
- F. Applied Music
- H. Honors

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Music 590. Special Topics. Cr. var. F.S.SS. *Prereq: Permission of instructor, approval of department head.*

- A. Education
- B. Theory
- C. Composition
- D. History
- E. Literature
- F. Applied Music

Music 593. Workshops. Cr. var. each time taken.

- A. Foundations of Music Learning
- B. Music in Early Childhood
- C. Junior High School Music Programs
- D. Instrumental Teaching Techniques
- E. Research in Music Education
- F. Vocal/Choral Teaching Techniques

Naval Science

Gary E. Washburn, Chair of Department

Professors: Washburn

Instructors (Adjunct): Carter, Johnson, Leach, Slagle

The function of the Navy and Marine Corps officer education programs is to provide, by a permanent system of education in essential naval science and other academic subjects at civil education institutions, a source from which qualified officers may be available for the Navy and the Marine Corps and their reserve components.

Students who enter the Navy and Marine Corps officer education programs may apply for either of two programs: the NROTC scholarship program (full scholarship which includes books, tuition, laboratory fees, uniforms, and \$150 per month), or the college program (non-scholarship, limited financial assistance). Applicants for the scholarship program are selected through comprehensive nationwide competitive procedures. Applicants for the college program are selected by the Professor of Naval Science from among students already in attendance at or selected for admission by the university. This program involves financial assistance of \$1,500 for each of the last two academic years. NROTC students pursue their studies like other students except that they meet certain requirements that will prepare them to serve as naval officers after graduation. A scholarship program student incurs a minimum 4-year active duty military obligation as a commissioned officer after graduation; a college program student incurs a 3-year active duty obligation. If a scholarship student fails to earn a degree, or if a commission is not tendered (for other than physical reasons), the student may incur a 2-year obligation in an enlisted grade or may be required to reim-

burse the government for scholarship costs. This obligation is not incurred during the freshman year. Information is available from the Professor of Naval Science, Iowa State University.

While in the program, students will participate in summer at-sea training cruises with pay, and will be expected to take part in extracurricular activities that will help them decide which field of the Navy or Marine Corps they wish to enter. These activities include three cruises for scholarship and one for nonscholarship students; several student societies; and indoctrination trips to a naval air station, a submarine base, and a Marine Corps base.

Undergraduate Study

Naval science courses are primarily for those students in the NROTC program. However, other university students may also enroll in naval science courses.

All students enrolled in the NROTC program must fulfill the following requirements:

1. N S 111, 210, 211, 212, 311, 312, 411, 412. Marine option students will substitute N S 321 and 421 for the 300 and 400 series listed above. Hist 390 may be substituted for N S 212. Mgmt 370 may be substituted for N S 411.
2. All NROTC students must complete one course in American military history or national security policy. A computer science course is required of all Navy-option students.
3. All Navy option scholarship students must successfully complete Math 165, 166 by the end of the sophomore year; Phys 221, 222 by the end of the junior year.
4. In addition to the normal naval science courses, all NROTC students are required to participate in laboratory periods that supplement the various academic courses; emphasize human relations principles; teach basic military formations, movements, commands, courtesies, and honors; and provide practice in unit leadership.
5. Navy option scholarship students are encouraged to major in engineering and physical sciences to meet the technological requirements of the modern Navy; however Navy-option students and Marine Corps option students may pursue any major leading to a bachelor's degree.

The College of Liberal Arts and Sciences offers a minor in naval science. Requirements for the minor are a minimum of 20 hours and are N S 111, 210, 211, 311 or 321, 312, 411 or 421, and 412. The minor must include at least 6 credits in courses numbered 300 or above taken at Iowa State University with a C or better.

For basic undergraduate curriculum requirements, see *Liberal Arts and Sciences, Curriculum; or Engineering, Curricula.*

Courses Primarily for Undergraduate Students

N S 111. Introduction to Naval Science. (3-0) Cr. 3. F. Introduction to the organization, regulations, and capabilities of the Navy, with emphasis on mission and principal warfare components. Course also covers seamanship, shiphandling, and human resource management.

N S 210. Naval Ship Systems I (Engineering). (3-0) Cr. 3. S. An introduction to naval engineering with emphasis on the equipment and machinery involved in the conversion of energy for propulsion and other purposes aboard the major ship types of the U.S. fleet. Basic concepts of the theory and design of steam, gas turbine, diesel, and nuclear propulsion. Introduction to ship design, stability, hydrodynamic forces, compartmentation, electrical and auxiliary systems, damage control.

N S 211. Naval Ship Systems II (Weapons). (3-0) Cr. 3. F. Introduction to the theory and principles of operation of naval weapon systems. Includes coverage of types of weapons and fire control systems, capabilities and limitations; theory of target acquisition, identification and tracking; basics of Naval Ordnance.

N S 212. Seapower and Maritime Affairs. (3-0) Cr. 3. S. Development of concept of seapower including the Merchant Marine; role of various warfare components of the Navy in supporting the Navy's mission; implementation of seapower as an instrument of national policy; a comparative study of U.S. and Soviet naval strategies.

N S 311. Navigation and Naval Operations. (3-0) Cr. 3. F. Study of ship navigation, movement and work; math analysis, spherical triangulation and practical work including piloting, celestial and electronic navigation, environmental factors affecting ship operations.

N S 312. Navigation and Naval Operations. (3-0) Cr. 3. S. Rules of the road and their application to effect safe ship navigation; relative motion, analysis and maneuvering of tactical formations; shipboard organization, seamanship, naval communications, command and control.

N S 321. Evolution of Warfare. (3-0) Cr. 3. Alt. F., offered 1999. Evolution of warfare from 3500 B.C. to contemporary times; analysis of the impact of historical precedents on modern military thought and action; emphasis on the historical development of military tactics, strategy, and technology.

N S 411. Leadership and Management I. (3-0) Cr. 3. F. Experiential approach to learning the principles of leadership and management by examining business management theories and their applications. Skills are developed in the areas of communication, counseling, control, direction, management, and leadership through active guided participation.

N S 412. Leadership and Management II. (3-0) Cr. 3. S. *Prereq: Junior classification.* Basic background concerning the duties and responsibilities of the junior naval officer and division officer in the areas of integrity and ethics, human resources management, personnel management, material management, and the administration of discipline. Preparation for responsibilities encountered immediately upon commissioning.

N S 421. Evolution of United States Amphibious Warfare. (3-0) Cr. 3. Alt. F., offered 2000. Defines the concept of amphibious operations, origins, development from 600 B.C.

N S 440. Senior Naval Science Seminar. (1-0) Cr. 1. F.S. Current leadership issues in the Navy which will challenge the newly commissioned officer. Opportunities to analyze, provide solutions, and discuss actions related to a variety of real world situations.

N S 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq: Senior classification, 6 credits in naval science.* No more than 9 credits of N S 490 may be counted toward graduation.

Neuroscience

(Interdepartmental Graduate Program)

Supervisory Committee: D. S. Sakaguchi, Chair; L. Anderson, V. Honavar, R. Hughes, S. Jęftinija

Graduate Study

Work is offered for the master of science and doctor of philosophy degrees with a major in neuroscience in cooperation with the departments of Animal Science; Biochemistry, Biophysics and Molecular Biology; Biomedical Sciences; Chemical Engineering, Computer Science; Entomology, Microbiology; Psychology; Veterinary Pathology; and Zoology and Genetics.

Facilities and faculty are committed to research in the following areas: neuronal membrane functions, signal transduction, neuroanatomy, neuroendocrinology, neurotoxicology, neuropathology, developmental neurobiology, neurogenetics, computational neuroscience, neural networks, and behavioral neuroscience.

An undergraduate or advanced degree in the sciences is ordinarily a prerequisite for admission to the program. A student majoring in neuroscience will select a major professor from the faculty participating in the program.

All students take a core curriculum consisting of Neuro 556, 557, 660, 690, 696, BBMB 404, and Stat 401. All students are also expected to take elective neuroscience courses from the following: Com S 474, E E 545, Psych 511, 517, 519; BMS 507, 511; V Pth 555; BMS 551, 551L, 565; Com S 474; E E 545; Zool 540.

Courses for Graduate Students

Neuro 556. Neurobiology. (Same as Zool 556.) (3-0) Cr. 3 to 4. F. *Prereq: Zool 355 or Psych 310; physics recommended.* Integration, coding, plasticity, and development in nervous systems. Materials fee.

Neuro 557. Advanced Neuroscience Techniques. (Same as Zool 557.) (0-6) Cr. 2. S. *Prereq: 556.* Research methods and techniques; exercises and/or demonstrations representing individual faculty specialties.

Neuro 660. Current Topics in Neurobiology and Behavior. (Same as Zool 660.) Cr. 2 to 3 each time taken. *Prereq: Permission of instructor.* Topics may include communication, computational neuroscience, hormones and behavior, neural integration, developmental neurobiology, neuroanatomy and ultrastructure, sensory biology, social behavior, techniques in neurobiology and behavior.

Neuro 690. Journal Club in Neuroscience. (1-0) Cr. 1 each time taken. F.S. *Prereq: 556.* Students are required to attend and make at least one presentation at a weekly journal club focusing on current topics.

Neuro 696. Neuroscience Seminar. (1-0) Cr. 1 each time taken. F.S. *Prereq: 556.* Presentations and discussion of research by students, faculty, and visiting scholars.

Neuro 699. Research.

Officer Education Programs

Iowa State University offers Reserve Officer Training Corps (ROTC) programs for the professional training of officers for the Army, Air Force, Navy and Marines.

The purpose of these programs is to provide an avenue for interested students to become reserve or regular officers in one of the United States military services, and the university regards this training as the foundation for possible careers in the military. The Air Force and the Navy require a period of active duty service upon completion of the ROTC program. Graduates from Army ROTC serve in either active Army, the Army Reserve, or the National Guard.

All students enrolled in advanced ROTC programs receive financial allowances, which are described under Student Financial Aid. Scholarships are also available for all services as outlined in the section on financial aid.

For specific courses and programs see also *Air Force Aerospace Studies, Military Science, and Naval Science.*

Pest Management

(Interdepartmental Undergraduate Program)

Advisory Committee: Larry Pedigo, Chair; Hall, Gibson, McNabb, Minner, Pease

The pest management program is designed for students with a career interest in the science and technology of pest management. Students in the program conduct inter-disciplinary studies with plant diseases, insects, weeds, and other pests, emphasizing the development of management systems that are ecologically and economically sound, as well as sustainable. The interdisciplinary nature of the program is reflected in the departmental sponsors—Agronomy, Animal Ecology, Plant Pathology, Entomology, Forestry, and Horticulture.

Pest management is an undergraduate secondary major that may be taken only in conjunction with a primary major. For example, the student may wish to take a primary major in agronomy, forestry, entomology, or some other life science and use elective credits to satisfy the requirements of the pest management major. Graduates have a broad knowledge of agricultural, horticultural, forest pests, as well as those of man and animals. Graduates can diagnose pest problems and recommend ecologically and economically sound systems to alleviate these problems. They are well versed on the pest concept, are able to identify pests and symptoms of pest injury, and understand the economics of decision making. Moreover, graduates are aware of technologically advanced pest management tactics and are skilled in applying these. Students educated in pest management may find employment opportunities with governmental agencies (state and federal), agricultur-

al chemical companies, food-processing firms, consulting agencies, urban pest control companies, timber companies, and other concerns that produce, process, and market the nation's food and fiber.

Students wishing to enroll in the pest management curriculum must register with the chair of the advisory committee. After consultation with the chair, a pest management adviser will be assigned, depending on the interests of the student. The student should indicate interest in pest management as early as possible in order that requirements of the program be effectively integrated with those of the primary major.

A pest management minor may be earned by completion of at least 15 credits of pest management or related courses taken at ISU. The courses that must be taken for a minor are: Agron 317; Ent 376; PL P 407. The remainder of the 15 credits are to be selected from the following: Ent 374; PL P 416; P M 491, 499. Courses required in a student's major may not be applied toward the pest management minor. Contact the pest management chair for more details.

Courses open for nonmajor graduate credit: 376, 407, 416.

Courses Primarily for Undergraduate Students

P M 283. Pesticide Applicator Certification. (Same as Ent 283.) See *Entomology*.

P M 317. Principles of Weed Science. (Same as Agron 317.) See *Agronomy*.

P M 376. Fundamentals of Entomology and Pest Management. (Same as Ent 376.) See *Entomology*. Nonmajor graduate credit.

P M 407. Principles of Plant Pathology. (Same as PL P 407.) See *Plant Pathology*. Nonmajor graduate credit.

P M 416. Forest Pest Management. (Same as PL P 416.) See *Plant Pathology*. Nonmajor graduate credit.

P M 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq: Junior or senior classification, 3 credits in pest management, permission of instructor, and written plan of study approved by pest management curriculum chair.* A maximum of 6 credits of 490 may be used toward the total of 128 credits required for graduation.

P M 491. Pest Management Experience. Cr. 2. *Prereq: 6 credits in pest management; permission of instructor.* Practical experience (internship) in management of plant diseases, insect populations, weeds, and other pests. Diagnosis, problem assessment, and control procedures are emphasized. For majors and advanced students.

P M 499. Pest Management Seminar. Cr. 1. F. *Prereq: Senior classification.* Current topics of interest to pest management.

Philosophy and Religious Studies

Michael Bishop, Chair of Department
Philosophy Faculty

Professors: Hollinger, Kupfer, Robinson,
Smith, Wilson

Professors (Emeritus): Klemke, Van Iten

Associate Professors: Bishop, Holmgren

1999-2001

Assistant Professors: Davidson, Svatos

Religious Studies Faculty:

Associate Professors: Avalos, Comstock,
Sawyer, Vidal

Assistant Professors: Baum, Gross, Sanford
Professors (Emeritus): Hollenbach

Philosophy

Undergraduate Study

The major in philosophy offers study in the important ideas, values, and ways of thinking that underlie cultural, social, and political processes, and that direct the specialized search for knowledge. Philosophical study broadens the student's educational experience and facilitates more effective participation in the human community.

An undergraduate major in philosophy should have a broad background in the liberal arts and sciences. The major program includes both a core and electives to provide a thorough acquaintance with the history of philosophy and further concentration in historical and systematic issues. An undergraduate major in philosophy can prepare the student for graduate work in philosophy, and also for further study in law, history, theology, religion, political science, social and political theory, or literature.

The degree program in philosophy requires a minimum of 27 credits in the core program and 6 credits of electives chosen from the remaining courses listed in the 300 or 400 levels.

The following courses compose the basic core program of the department from which 27 credits shall be chosen.

- a. Introduction: 201 (required).
- b. Logic: 207 (required).
- c. Ethical theory: one course required. Choose from 330, 335.
- d. Applied ethics: one course required. Choose from 230, 331, 333, 336, 442.
- e. History: Three courses required, at least one each from group A and group B: A. 310, 314, 315; B. 316, 317, 318.
- f. Two 400-level courses required.

The department offers a minor in philosophy which may be earned by completing a total of 15 credits in philosophy including 201 and at least 6 credits in courses numbered 300 or above. Students may want to emphasize specific areas by taking 15 hours of courses chosen from the following:

Philosophy of Science: 201, 206 or 207, 314, 315, 380, 381, 480

History of Philosophy: 201, 310, 314, 315, 316, 317, 318; 460 or 470

Social Values and Policy: 230, 235, 331, 332, 333, 335, 336, 338, 430, 442

English proficiency requirement: The department requires a grade of C+ or better in each

of Engl 104 and 105 (or 105H), and approval of writing by instructor of one history of philosophy course (310-318), to be designated by the student.

Graduate Study

The department offers a graduate minor in philosophy. For those taking the M.A. or M.S., the minor requirement is two courses above 300 (but not 490) taken in conjunction with 590. For those taking the Ph.D., the requirement is four courses above 300, at least one of which is above 400 (but not 490) all taken in conjunction with 590. Interested students should ask the chair to assign a minor adviser.

The department participates in the interdepartmental program in general graduate studies. (See *Index*.)

Courses open for nonmajor graduate credit: All courses numbered above 300 except 490.

Courses Primarily for Undergraduate Students

Phil 201. Introduction to Philosophy. (3-0) Cr. 3. F.S.SS. It has been rumored that the unexamined life is not worth living. Philosophy is an attempt to begin examining life by considering such questions as: What makes us human? What is the world ultimately like? How should we relate to other people? Is there a god? How can we know anything about these questions? Understanding questions of this kind and proposed answers to them is what this course is all about.

Phil 206. Introduction to Logic and Scientific Reasoning. (3-0) Cr. 3. F.S.SS. Basic principles of critical reasoning and argument evaluation. A consideration of basic forms of argumentation in science and everyday life. Application to contemporary issues and controversies. This course is not recommended for students majoring in math, science, or engineering.

Phil 207. Introduction to Symbolic Logic. (Same as Ling 207.) (3-0) Cr. 3. S. Introduction to fundamental logical concepts and logical symbolism. Development of natural deduction through first order predicate logic with identity. Applications to arguments in ordinary English and to philosophical issues. Majors should take 207 as early as possible.

Phil 230. Moral Theory and Practice. (3-0) Cr. 3. F.S.SS. Investigation of moral issues in the context of major ethical theories of value and obligation; e.g., punishment, abortion, economic justice, job discrimination, world hunger, and sexual morality. Emphasis on critical reasoning and argument analysis.

Phil 235. Ethical Issues in A Diverse Society. (3-0) Cr. 3. S. This course will examine a range of arguments on diversity issues. Topics will include: the social status of women, the moral status of sexuality and homosexuality, the nature and role of racism in contemporary society, the relationship between biology, gender roles and social status, and various proposals for change from a variety of political perspectives.

Phil 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Phil 310. Ancient Philosophy. (Same as Cl St 310.) (3-0) Cr. 3. F. *Prereq: 201.* Survey of the principal philosophers of the ancient world: the pre-Socratics, Plato, Aristotle, the Stoics and the Epicureans. Questions concerning being, knowledge, language, and the good life are treated in depth. Nonmajor graduate credit.

Phil 314. 17th Century Philosophy. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 201.* Readings from philosophers such as Hobbes, Descartes, Spinoza, Leibniz,

and Locke. Changing conceptions of knowledge, self, and deities in response to Galileo's new science and post-reformation challenge to ecclesiastical authority. Nonmajor graduate credit.

Phil 315. 18th Century Philosophy. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 201. Readings from philosophers such as Berkeley, Hume, and Kant. Development of Enlightenment thought. Issues include idealism, causation, freedom, and knowledge regarding science, ethics, and deities. Nonmajor graduate credit.

Phil 316. 19th Century Continental Philosophy. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 201. The thought of Hegel, Marx, Nietzsche, and their contemporaries. Various perspectives on the philosophy of history, the nature of reason and subjectivity, the contrast between dialectical and nondialectical philosophy, and the relationship between philosophy and society. Nonmajor graduate credit.

Phil 317. 20th Century Continental Philosophy. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 201. An examination of 20th century continental philosophy against the background of the 19th century continental tradition. Movements covered include: Phenomenology, Marxism, Postmodernism, Post-structuralism, Feminism. Focus on attempts to develop history, society, and politics; debates about the crisis of reason and culture; political issues surrounding such debates. Nonmajor graduate credit.

Phil 318. 20th Century Anglo-American Philosophy. (3-0) Cr. 3. S. *Prereq:* 201. Major movements in recent philosophy such as realism, logical positivism, ordinary language philosophy, and naturalism. Russell, Wittgenstein, Quine and other leading figures. Topics include knowledge of the material world, mind, language, values, and philosophical method. Nonmajor graduate credit.

Phil 320. Existentialism and Its Critics. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 201. An investigation of Existentialism and its critics in historical and cultural context. Emphasis on existential phenomenology and French existentialism, and on criticisms. Existential Marxism and Heidegger's later philosophy. Nonmajor graduate credit.

Phil 330. Ethical Theory. (3-0) Cr. 3. F. *Prereq:* 201 or 230. Major theories in normative ethics and metaethics. Includes such views as relativism, emotivism, and absolutism. Comparison of ethics with science and how moral judgments are justified. Nonmajor graduate credit.

Phil 331. Moral Problems in Medicine. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 230 or junior classification. In-depth study of some of the central moral problems arising in medicine, e.g., abortion, euthanasia, patients' rights, health care professionals' duties and responsibilities, allocation of medical resources. Major moral theories will be examined and applied. Nonmajor graduate credit.

Phil 332. Philosophy of Law. (Same as CJ St 332.) (3-0) Cr. 3. F.S. *Prereq:* 201 or 230. Extent of our obligation to obey the law; what constitutes just punishment; how much of the immoral should be made illegal? Relation of these questions to major theories of law and the state. Discussion of such concepts as coercion, equality, and responsibility. Nonmajor graduate credit.

Phil 333. Family Ethics. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 3 credits in philosophy. Moral dimensions of marriage and love, parent-child relations, domestic work, and moral education. Can parents and children be friends? What do children "owe" their parents? Is there a feminist mode of moral thinking? Nonmajor graduate credit.

Phil 334. Environmental Ethics. (Same as Env S 334.) (3-0) Cr. 3. F. *Prereq:* 3 credits in philosophy or junior classification. Thorough study of some of the central moral issues arising in connection with human impact on the environment, e.g., human overpopulation, species extinction, forest and wilderness management, pollution. Several world views of the proper relationship between human beings and nature will be explored. Nonmajor graduate credit.

Phil 335. Social and Political Philosophy. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 201 or 230.

Foundations of social and political life. Metaphysical and epistemological grounds in classical and recent thinkers. The basis of political organization, the nature of social and political institutions, rights and authority, justice and the character of distinctly political action. Original texts. Nonmajor graduate credit.

Phil 336. Bioethics and Biotechnology. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* Phil 201 or 230 or 235, or permission of instructor. In-depth study of some central moral issues in the life sciences, e.g., genetic screening and testing, genetically engineered plants and animals, risk analysis, biotechnology patents, research ethics, biodiversity, the impact of biotechnology on society and the environment. Major moral theories will be discussed and applied. (Phil 336 contains almost no similarities to Phil 331.) Nonmajor graduate credit.

Phil 338. Feminism and Its Critics. (3-0) Cr. 3. S. This course will consider opposing viewpoints on topics such as pornography, gender roles, the family, housework, and sexuality. Emphasis on competing arguments and theoretical positions. Nonmajor graduate credit.

Phil 340. Aesthetics. (3-0) Cr. 3. F. *Prereq:* 201 or 230. Is liking all there is to appreciating works of art or natural beauty? We will examine our appreciative experiences, talk about such experiences (e.g., art criticism), and what makes them valuable. Do the different arts have common values? How are their differences important? Nonmajor graduate credit.

Phil 342. Philosophy of Technology. (Same as T SC 342.) (3-0) Cr. 3. F.S. *Prereq:* 6 credits of social science or T SC 341 and 3 credits of social science. Conditions under which technological innovations contribute to human emancipation, relationship of technology and democracy, utility and limits of technical rationality, and problems of ensuring that benefits of technological advance are communally shared. Issues discussed with reference to contemporary developments in microelectronics, technology transfer to the Third World, etc. Nonmajor graduate credit.

Phil 350. Philosophy of Religion. (Same as Relig 350.) (3-0) Cr. 3. F. *Prereq:* 201. The value and truth of religious life and belief. Mystical experience; religious faith and language; arguments for God's existence; the problem of evil; miracles; and religion and morality. Historical and contemporary readings from both the western and eastern traditions. Nonmajor graduate credit.

Phil 380. Philosophy of Science. (3-0) Cr. 3. F. *Prereq:* 201 or 6 credits in a science. Introduction to the philosophy of science. A variety of basic problems common to the natural and social sciences: the nature of explanation, the structure of theories, the unity of science, and the distinction between science and nonscience. Nonmajor graduate credit.

Phil 381. Philosophy of the Social and Behavioral Sciences. (3-0) Cr. 3. S. *Prereq:* 201 or 6 credits in the social sciences. Methodological, ideological, and doctrinal issues about the social and behavioral sciences against the background of influence of the natural sciences. Focus is on the historical and cultural background of 19th and 20th century western thought. Nonmajor graduate credit.

Phil 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of the department cooperative education coordinator; junior classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period. Nonmajor graduate credit.

Phil 430. Value Theory. (3-0) Cr. 3 each time taken, maximum of 6 credits. S. *Prereq:* 230. Theoretical and normative issues in ethics, aesthetics, religious thought, or political philosophy. Topics vary each time offered. Nonmajor graduate credit.

Phil 460. Epistemology and Metaphysics. (3-0) Cr. 3 each time taken, maximum of 6 credits. Alt. S., offered 2000. *Prereq:* 201 and at least one course in the history of philosophy. Issues in epistemology and metaphysics. Topics vary each time offered. Nonmajor graduate credit.

Phil 465. Brains, Minds, and Computers. (3-0) Cr. 3. F. *Prereq:* 201. Examination of concepts such as computability, intelligence, programming, and free

will; and of arguments about whether any human capacity is forever beyond realization in a machine. Nonmajor graduate credit.

Phil 480. Controversies in Science. (3-0) Cr. 3 each time taken. S. *Prereq:* 3 credits in philosophy or 6 credits in a natural or social science. Philosophical treatment of a branch of science that has (or has had) significant social, political, religious and/or moral implications. Possible topics include: the IQ debate, implications of Darwinism, the Galileo affair, the role of values in science, critical analysis of current science policy (e.g., the Human Genome Project). Topics will be arranged to meet the needs of interested students. Often team taught by a philosopher and a scientist from the relevant discipline. Nonmajor graduate credit.

Phil 490. Independent Study. Cr. 1 to 4 each time taken. *Prereq:* 6 credits in philosophy; permission of instructor, approval of chairman. No more than 9 credits of Phil 490 may be counted toward graduation. Guided reading and research on special topics selected to meet needs of advanced students.

H. Honors

Phil 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of the department cooperative education coordinator; senior classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period. Nonmajor graduate credit.

Courses Primarily for Graduate Students for minor credit, open to qualified undergraduates

Phil 535. Contemporary Political Philosophy. (Same as Pol S 535.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 6 credits of philosophy or political science. Examination of theories of justice proposed by contemporary political philosophers. Analysis of the philosophical foundations of perspectives such as liberalism, libertarianism, communitarianism, socialism, feminism. Normative assessments of socio-political institutions.

Phil 590. Special Topics in Philosophy. Cr. 2 to 4 each time taken. *Prereq:* Permission of instructor; 9 credits in philosophy.

- A. History of Philosophy
- B. Epistemology and Metaphysics
- C. Value Theory
- D. Logic and Philosophy of Science

Religious Studies (Relig) Undergraduate Study

Religious studies gives students the opportunity to investigate and reflect on the world's religions in an objective, critical, and appreciative manner. Though there is emphasis in religious studies on the wide variety of religious phenomena as well as on the various methods in the study of religion, the aim is to help students develop their own integrated understanding of the nature of religion and its role in individual and social life.

Graduates of the religious studies program have knowledge of the religious diversity in the United States and the world. They have the ability to interpret religion emphatically and critically and to compare and contrast historical and contemporary differences and similarities of religious systems. They understand ways in which religion influences and is influenced by the historical, social, and cultural contexts in which religious systems function. Graduates often pursue careers in non-profit, community organizations; apply to professional schools or graduate programs; or enter seminaries to prepare for ministry.

The program provides students with the following opportunities: to major or minor in reli-

gious studies, to fulfill group requirements, to take religious studies courses that are integrated into another major, to take religious studies courses as electives, and to develop an interdisciplinary studies major. (See the professor in charge of the religious studies program for advice.)

The major in religious studies seeks to provide both breadth and depth. Breadth is provided through the 200 level courses required for a major. The objective is to expose the student to various components of the discipline of Religious Studies and in so doing provide the foundation that would be required for entering a graduate program or seminary.

Depth is achieved through advanced courses that have a common focus on the role of religion in our contemporary world—both in the United States and internationally. In taking these courses, majors and others will be exposed to the cutting-edge of the discipline of religious studies.

Courses are offered in five essential areas of study: (1) history of religions (world religions); (2) religion in North America; (3) religion and culture; (4) theology, ethics, and philosophy of religion (including Catholic Studies); (5) biblical studies and church history.

Students pursuing a major in religious studies must complete a minimum of 33 credits, including the following requirements:

1. Introduction to World Religions (105);
2. 9 hours of 200 level courses;
3. 15 hours of advanced courses (300 or 400 level), including no more than six hours of independent study (490), no more than six hours of special studies in Biblical languages (494) and not counting 475.
4. 6 hours of seminar (475).

Students may choose to do a senior thesis under the supervision of a religious studies faculty adviser. This option may count 3 credits toward the completion of the major.

The program offers a minor in religious studies which may be earned by completing a total of 15 credits in religious studies including 105, one 200-level course and at least 9 credits in courses numbered 300 or above (no more than 3 credits seminar and no more than 3 credits independent study).

English proficiency requirement: The department requires a grade of C or better in each of English 104 and 105 (or 105H), and requires one 300 level course in religious studies in which writing is evaluated as acceptable.

Graduate Study

The program offers courses for graduate minor work in religious studies as supporting work for other fields. Religious studies may also be one of the three areas required for the general graduate studies master's degree.

Courses open for nonmajor graduate credit: 321, 322, 334, 336, 338, 350, 352, 353, 354, 365, 370, 377, 385, 475.

Courses Primarily for Undergraduate Students

Relig 105. Introduction to World Religions. (3-0) Cr. 3. F.S.SS. An introduction to the academic study of religions, including myths, beliefs, rituals, values, social forms. Examples chosen from oral cultures and major religions of the world.

Relig 210. Religion in America. (3-0) Cr. 3. F.S.SS. Introductory study of the major beliefs, practices, and institutions of American Judaism, Catholicism, Protestantism, and Islam with emphasis on the diversity of religion in America, and attention to issues of gender, race, and class.

Relig 220. Introduction to the Bible. (3-0) Cr. 3. F.S. Basic overview of the contents of the Old and New Testament in light of their ancient socio-historical background, and with attention to a variety of interpretations and relevance to modern American society.

Relig 233. Introduction to Judaism. (3-0) Cr. 3. An introduction to basic Judaism. Special attention is given to Jewish sacred texts, rituals, social practices, and modern forms.

Relig 240. Christian Theology. (3-0) Cr. 3. Treats contemporary Christian theology from both Protestant and Catholic perspectives, emphasizing theological responses to scientific and secular views and social movements.

Relig 242. History of Christianity. (3-0) Cr. 3. F.S.SS. An introduction to Christian thought and practice from an historical point of view, stressing the development of belief, spirituality, and organization, and the continuities and changes involved in these developments.

Relig 260. Religious Ethics. (3-0) Cr. 3. Investigates different religious ethical theories and traditions of reasoning about practical moral issues (e.g., abortion, the just distribution of wealth, environmental ethics). Explores in detail the relationship between religious beliefs and moral practice.

Relig 280. Introduction to Catholicism. (3-0) Cr. 3. F. An introduction to Catholic belief and practice. The Catholic *ethos* will be located in the context of other world religions, and special stress will be placed on the central beliefs of the Creed as understood by Catholics, and on sacramentality as the distinguishing mark of the Catholic worldview.

Relig 321. Old Testament. (3-0) Cr. 3. F. An in-depth study of the literature and religion of ancient Israel in light of recent archaeological discoveries, research about the ancient Near East, and a variety of interpretations. Nonmajor graduate credit.

Relig 322. New Testament. (3-0) Cr. 3. A detailed survey of the sacred scriptures of Christianity in light of recent archaeological discoveries and historical research about their Greco-Roman and Jewish background. Nonmajor graduate credit.

Relig 323. Science and Religion. (Same as Hist 323.) See *History*.

Relig 334. African American Religious Experience. (Same as Af Am 334.) (3-0) Cr. 3. Alt. F., offered 2000. Examination of the African American experience from the perspective of black religion and the black church, with attention to political, economic, and social, as well as spiritual, concerns. Nonmajor graduate credit.

Relig 336. Women and Religion. (Same as W S 336.) (3-0) Cr. 3. F. *Prereq:* 105, 210 or W S 201 *recommended*. Examines the status of women in various religions, feminist critiques of religious structures and belief systems, and contemporary women's spirituality movements. Nonmajor graduate credit.

Relig 338. Latino/a Religious Experience. (3-0) Cr. 3. S. Historical and cultural survey of the religious experience of Mexican Americans, Puerto Ricans, Cuban Americans, and other groups in the U.S. who trace their roots to the Spanish-speaking countries of Latin America. Nonmajor graduate credit.

Relig 340. Magic, Witchcraft, and Religion. (Same as Anthr 340.) See *Anthropology*.

Relig 350. Philosophy of Religion. (Same as Phil 350.) See *Philosophy*. Nonmajor graduate credit.

Relig 352. Religious Traditions of India. (3-0) Cr. 3. F. *Prereq:* 105. Examines the religious traditions of India, including Hinduism, Jainism, and Sikhism, through text, ritual, and contemporary practice. Nonmajor graduate credit.

Relig 353. Buddhism. (3-0) Cr. 3. S. *Prereq:* 105. The various Buddhist paths to realize enlightenment and freedom. Special attention to meditation and yoga and their relationship to altered states of consciousness and to social contexts. Nonmajor graduate credit.

Relig 354. Islamic Civilization. (3-0) Cr. 3. S. *Prereq:* 105. An introduction to Islamic religion, culture, and society from 700 to the present. Nonmajor graduate credit.

Relig 365. Western Religious Traditions. (3-0) Cr. 3. *Prereq:* 105. Religious traditions of Judaism, Christianity and Islam comparing their doctrinal, institutional, and ritual systems and social histories. Nonmajor graduate credit.

Relig 370. Religion and Politics. (Same as Pol S 370.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 105 or 210 *recommended*. The interaction of religion and politics in the U.S. from both an historical and contemporary perspective, as well as the role of religion in politics internationally. Nonmajor graduate credit.

Relig 376. The Archaeology of Greek and Roman Religions. (Same as Cl St 376.) See *Classical Studies*.

Relig 377. Social Dimensions of Religion. (Same as Soc 377.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 210, or Soc 130 or 134 *recommended*. The influence of religion in society, both as a conservator of values and as a force for social change. Nonmajor graduate credit.

Relig 385. Theory and Method in Religious Studies. (3-0) Cr. 3. *Prereq:* 105. Examines the variety of theories and methods employed in the study of religion. Application of these methods to various religions of the world. Nonmajor graduate credit.

Relig 475. Seminar: Issues in the Study of Religion. (Same as Af Am 475.) (3-0) Cr. 3 each time taken, maximum of 6 credits. *Prereq:* 6 credits in religious studies. Topic changes each time offered. When content is appropriate, may be taken as Af Am 475. Nonmajor graduate credit.

Relig 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq:* 6 credits in religious studies, and permission of instructor, approval of professor in charge of program. No more than 9 credits of Relig 490 may be counted toward graduation. Guided reading and research on special topics selected to meet the needs of advanced students.

H. Honors

Relig 491. Senior Thesis. Cr. 3. Written under the supervision of a Religious Studies faculty advisor.

Relig 494. Special Studies in Biblical Languages. Cr. 2 to 3 each time taken. *Prereq:* 6 credits in Religious Studies and permission of instructor; approval of professor in charge of program.

Relig 499. Peace and Justice Internship. Cr. var., maximum of 6. *Prereq:* 3 credits in religious studies, permission of faculty internship coordinator. Supervised placement with a peace and justice agency; structured reflection on the relation of religion and practical social issues. Offered on a satisfactory-fail grading basis only.

Relig 590. Special Topics in Religious Studies. Cr. 1 to 3 each time taken. *Prereq:* Permission of instructor, 9 credits in religious studies.

Physics and Astronomy

Douglas Finne more, Chair of Department

Distinguished Professors: Clem, Finne more, Harmon, Ho, Lynch

University Professors: Willson

Professors: Anderson, Borsa, Carter-Lewis, Crawley, Firestone, Goldman, Hauptman, Hill, Hodges, Johnston, Kawaler, Kelly, Lassila, Leacock, Luban, Peterson, Rosenberg, Ross, Shinar, Soukoulis, Stanford, Stassis, Struck, Tringides, Vary, Weber, Wohn, Wolford, Young

Professors (Adjunct): Meyer

Distinguished Professors (Emeritus): Ruedenberg, Swenson, Zaffarano

Professors (Emeritus): Barnes, Bowen, Fuchs, Kernan, Lamb, Pursey, Stewart, Williams

Associate Professors: Appleton, Canfield, Qiu, Valencia, Whisnant

Associate Professors (Adjunct): Biswas, Kogan

Assistant Professors: Cochran, Krennrich, Lajoie, Lavery, Meltzer, Modler, Rosati

Assistant Professors (Adjunct): Atwood, Miller, Shanks, Vaknin

Undergraduate Study

For the undergraduate curriculum in liberal arts and sciences, major in physics, leading to the degree bachelor of science, see *Liberal Arts and Sciences, Curriculum*.

Physics and astronomy are basic natural sciences which attempt to describe and provide an understanding of both our world and our universe. Physics serves as the underpinning of many different disciplines including the other natural sciences and technological areas. Graduates are proficient in the methods of rigorous scientific analysis, relevant mathematical techniques, and modern computational and laboratory methods. They have a broad knowledge of physics, including mechanics, electricity and magnetism, thermodynamics, and modern physics. They are able to communicate clearly and effectively at general and technical levels. They are prepared to pursue a wide range of careers as a professional physicist, astronomer, or science educator. They are also prepared to pursue advanced studies and careers in areas as diverse as engineering, medicine, law, and business administration.

Many opportunities exist for students who terminate their studies with a bachelor's degree, especially when combined with technology studies in other areas. Students who meet the necessary scholastic standards often continue their studies in a graduate college, exploring and contributing to new developments in the field.

The department normally expects each student majoring in physics to complete at least the following courses: Phys 221, 222, 232, 321, 321L, 322, 322L, 304, 306, 361, 364, and

three credits of laboratory work chosen from 310, 311, 311T, 470L, or Astro 344L. All students are required to earn at least 5 credits in laboratory work in physics in addition to the laboratory components of Phys 221 and 222. These 5 credits must be in courses numbered 300 or higher or in approved substitutions. All students must earn at least 20 credits in physics and astronomy courses numbered 304 or higher. A student must earn an average grade of C (or better) in astronomy and physics courses taken at Iowa State University to receive a B.S. in physics. The basic list of expected courses is not a rigid requirement and changes in this basic list will be approved by the department curriculum committee on recommendation of the student's advisor when such changes will better serve the student's needs. In particular, students planning a physics major and also seeking certification for high school teaching may, with the approval of their adviser, follow a significantly different program designed to meet their particular needs; these students should consult the department for further information. Further information concerning programs of study, including sample degree programs, is available from the department.

Students majoring in physics who wish an emphasis in astronomy or astrophysics should consider a minor in astronomy (see below). Those planning graduate work in physics, astronomy, or astrophysics should add to the basic list the courses Phys 362, 365, 480, 481, and 496. One or more of Astro 405, Phys 511, 524, or 537 may also be added according to interest. Such students are also strongly encouraged to study at least one foreign language and to become computer and computation literate.

The department offers a minor in physics which may be earned by completing 20 credits in physics courses chosen as follows: Phys 221, 222; either 321 or 324; at least one credit of laboratory chosen from 321L, 322L, 310, 311, and 311T. Other acceptable courses are 304, 306, 322, 361, 362, 364, 365, 480, 481, and 496.

The department offers a minor in astronomy which may be earned by completing 15 credits chosen as follows: a total of 12 or more credits in Astro courses (must include Astro 344L and may include one of the courses Astro 120, Astro 150 or Astro 250), with the remaining 3 credits (if applicable) chosen from among Physics 304, 321, 324, 361, 362, 364, 365, 480, 481, or 496; 12 or more credits must be at the 300 level or higher. Note that the same course may not be used to satisfy both the requirements of a physics major and an astronomy minor.

English proficiency requirement: The department requires a grade of C or better in each of Engl 104 and 105 (or 105H), and a C- or better in Engl 305 or 314.

Graduate Study

The department offers studies for the degrees master of science and doctor of philosophy with majors at both levels in applied physics, astrophysics, condensed matter physics, high

energy physics, nuclear physics, and physics; and minor credit courses for students majoring in other departments. The department also offers studies for the degrees master of science and doctor of philosophy in applied physics

Facilities of various research groups of the department, the Ames Laboratory, and the Applied Science Center, including the Microelectronics Research Center, are available for research.

Students with bachelor's degrees in physics or astronomy from other institutions ordinarily will qualify for graduate study at Iowa State provided they have satisfactorily completed course work similar to that suggested for undergraduate majors here intending to go on to graduate school. In some cases additional instruction at the intermediate level may be required.

Graduates have a broad understanding of physical science, as well as mastery of state-of-the-art methods in their area of specialization. They are able to communicate effectively to a wide range of audiences, from the general public to research colleagues. Their skills in rigorous scientific thinking prepare them for leadership in the broader community. They are skilled in carrying out research, communicating research results, and soliciting research support. They have considerable teaching experience. They have developed problem solving skills that prepare them for careers in either industry or academia.

All candidates for an advanced degree in physics are expected to complete Phys 571, 572, 591, and either 531 or 564. Candidates for an advanced degree in applied physics are expected to complete Phys 571, 591, 470L (6 cr.), 699 (3 cr.), and either 572 or 531.

Except for the applied physics major where a thesis is always required, the degree master of science is offered both with and without thesis.

For all areas of study except applied physics the basic requirements for the M.S. are the same: At least 30 credits of acceptable graduate work must be completed, not less than 21 of which must be in physics or astronomy. Students must complete not less than 6 credits from outside their major area of which 3 must be taken from other departments.

Students choosing a degree with thesis may apply up to 8 credits of 699 but no credits of 599 toward the minimum 30 credits. Students choosing a degree without thesis should apply 2 credits of 599, but may not apply any credits of 699 toward the minimum 30 credits.

Students whose major area is applied physics must complete at least 30 credits of acceptable graduate work and not less than 19 credits of these must be in the required courses listed above; the remaining 11 credits of the 30 credit minimum may be chosen freely either from within the students major area or from without and either from the department or outside, but it should be noted that not more than 3 credits of Phys 699 may be applied toward the 30 credit minimum.

In addition to the list of basic courses above,

all candidates for the doctor of philosophy degree, except those in astrophysics, must also complete Phys 592. Individual areas may impose additional requirements. In addition to course work in the major area of study a candidate must complete 12 credits from outside this area. Of these 6 must be taken from other departments and 6 must be taken from the department with the additional constraint that this latter 6 must include at least one 500 or 600 level introductory course in another area of specialization. Each candidate for the doctor of philosophy degree is required to teach one year of elementary physics or astronomy.

Graduate students interested in a physics minor should contact the department for requirements.

Courses open for nonmajor graduate credit: Phys 304, 310, 311, 324, 361, 362, 364, 365, 480, 481, 496, and Astro 342, 344L, 346.

Astronomy and Astrophysics (Astro) Courses Primarily for Undergraduate Students

Astro 120. The Sky and the Solar System. (3-0) Cr. 3. F.S.SS. For the nonscientist. The sky: constellations; motions of the sun, moon, and planets; seasons and the calendar; eclipses. The solar system: origin and evolution; characteristics of the sun, planets, satellites, comets, meteorites, and asteroids. Extensive use of the planetarium is included.

Astro 125L. The Sky and the Solar System Laboratory. (0-2) Cr. 1. F.S. *Prereq:* *Concurrent or previous enrollment in Astro 120.* Laboratory course to accompany Astro 120. Students carry out practical exercises involving naked eye and telescopic observing to explore and reinforce ideas covered in Astro 120. Activities based on a sky-simulation computer program and other computer-based exercises are also included.

Astro 150. Stars, Galaxies, and Cosmology. (3-0) Cr. 3. F.S. For the nonscientist. Observational aspects of stellar astronomy: motions, distances, sizes, spectra; types of stars: variability; binary systems. Stellar evolution: the birth, life, and death of stars, including supernovae, neutron stars, and black holes. The Milky Way Galaxy: clouds of matter in space, the structure and evolution of our galaxy. Other galaxies, clusters of galaxies, quasars. Theories of the origin of the universe.

Astro 250. Astronomy Bizarre. (3-0) Cr. 3. S. *Prereq:* *120 or 150.* For the nonscientist. New and exciting topics in modern astronomy. Galaxy and star formation. Black holes and pulsars. Colliding galaxies. Quasars. Cosmology, the Big Bang and the future of the universe. Prospects and searches for extraterrestrial life.

Astro 290. Independent Study. Cr. 1 to 4 each time taken. *Prereq:* *Permission of instructor.*

Astro 342. Introduction to Solar System Astronomy. (3-0) Cr. 3. F. *Prereq:* *Phys 222.* Analytical and comparative studies of solar system objects—planets, satellites, rings, asteroids, comets, meteoroids, and interplanetary dust—with emphasis on the physical processes affecting them, their interactions, and their evolution. Orbital mechanics, including perturbations, stability, and resonances. Tidal forces and effects. Radiation laws and thermal physics with applications. Brief study of the sun as a star, and of stellar evolution. Origin and evolution of the solar system. Detection of other planetary systems. Nonmajor graduate credit.

Astro 344L. Astronomy Laboratory. (1-6) Cr. 3. F. *Prereq:* *Phys 222.* Experiments in optical astronomy. Observational techniques, ranging from stellar photometry to astrophotography. Available instruments include 8" Meade, 14" Celestron and Schmidt cameras. Class meets at Fick Observatory south of Boone. Nonmajor graduate credit.

Astro 346. Introduction to Astrophysics. (3-0) Cr. 3. S. *Prereq:* *Phys 222.* Basic radiation theory; spectra. Observational determination of stellar properties; spectral classification. Binary systems. Stellar structure and evolution. White dwarfs, neutron stars, black holes. The Galaxy: structure and composition; the interstellar medium. Other galaxies; active galaxies; cosmology. Nonmajor graduate credit.

Astro 405. Astrophysics. (Dual-listed with 505.) (3-0) Cr. 3. F. *Prereq:* *342 or 346; Math 266.* Survey of astrophysics at an advanced level. Physics of stars, galaxies, and the universe. Stellar spectra, structure and evolution. Origin of the elements. Black holes, neutron stars and white dwarfs. Large scale structure of the universe, dark matter, Big Bang Cosmology.

Astro 450. Undergraduate Research. Cr. 1 to 6 each time taken. F.S.SS. *Prereq:* *Permission of instructor.* Research under supervision of astronomy faculty.

Astro 450L. Undergraduate Research. Cr. 1 to 6 each time taken. F.S.SS. *Prereq:* *344L and permission of instructor.* Laboratory or observational project under supervision of astronomy faculty.

Astro 490. Independent Study. Cr. 1 to 4. *Prereq:* *6 credits in astronomy, permission of instructor.* No more than 9 credits of Astro 490 may be counted toward graduation.
H. Honors

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Astro 505. Astrophysics. (Dual-listed with 405.) (3-0) Cr. 3. F. *Prereq:* *342 or 346; Math 266, permission of instructor.* Survey of astrophysics at an advanced level. Physics of stars, galaxies, and the universe. Stellar spectra, structure and evolution. Origin of the elements. Black holes, neutron stars and white dwarfs. Large scale structure of the universe, dark matter, Big Bang Cosmology.

Astro 510. Observational Astrophysics. (2-3) Cr. 3. Alt. S., offered 2000. *Prereq:* *405 or 505.* Techniques in optical and near-IR astronomy, including spectroscopy and photometry with both single channel and 2-dimensional array detectors. Emphasis on projects involving proficiency in the use of research telescopes and modern instrumentation. Project topics range from spectroscopic and photometric studies of pulsating and binary star systems to deep photographic and CCD imaging of faint nebulae and galaxies.

Astro 518. Radio Astronomy and Astrophysics (Same as E E 518.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* *Phys 365 or E E 313.* Radio astronomy fundamentals; wave polarization and measurement; radio telescope receivers and antennas; wave propagation in plasmas; synchrotron emission; continuum and line spectra; physical conditions in radio sources.

Astro 575. Radiative Transfer, Stellar Atmospheres, and Spectroscopy. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* *405 or 505.* Radiative transfer with applications to stellar interiors, atmospheres, and the interstellar medium. Interaction of radiation and matter; line and continuum processes. Statistical equilibrium. Line profiles. Interpretation of stellar spectra: temperature, pressure, and abundance determinations. Dynamic and extended atmospheres, chromospheres, coronae, and stellar winds.

Astro 580. Stellar Structure and Evolution. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* *405 or 505.* Stellar structure equations and constitutive relations: energy generation, energy transport by radiation and convection; equation of state. Solutions to the equations: general theorems, analytic approximations, numerical techniques and results. Stellar evolution from formation to final phases. Nucleosynthesis; recycling of material to the interstellar medium. Evolution in interacting binaries. Variable stars.

Astro 590. Special topics. Cr. var.

Astro 599. Creative Component. Cr. var. *Prereq:* *Permission of instructor.* Individually directed study of research-level problems for students electing the nonthesis M.S. option in astronomy.

Courses for Graduate Students

Astro 615. Galactic and Extragalactic Astronomy. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* *405 or 505.* The interstellar medium, galactic structure, dynamics of external galaxies, evolution and classification of galaxies, extragalactic radio sources, quasars, cosmological models.

Astro 650. Advanced Seminar. (1-0) Cr. 1 each time taken. F.S. Topics of current interest in astronomy and astrophysics. Offered on a satisfactory-fail grading basis only.

Astro 660. Advanced Topics in Astronomy and Astrophysics. Cr. 1 to 3 each time taken. F.S. Topics in stellar, galactic, and extragalactic astronomy, including stellar evolution, solar physics, variable stars, compact objects, the interstellar medium, active galaxies and quasars, formation and evolution of galaxies, cosmology, high energy astrophysics, advanced observational techniques, and astrophysical applications of hydrodynamics.

Astro 699. Research.

Physics (Phys)

Courses Primarily for Undergraduate Students

Phys 100. Introductory Seminar. (1-1) Cr. R. F. Survey of recent scientific breakthroughs and current research of physics and astronomy faculty. Discussion of careers based on a major in physics. Offered on a satisfactory-fail grading basis only.

Phys 101. Physics for the Nonscientist. (3-0) Cr. 3. F.S. Survey of the principal areas of both classical and modern physics. Emphasis on the nature of the physical universe and the application of physical principles to life in the modern world.

Phys 106. The Physics of Common Experience. (4-2) Cr. 4. F.S. Elementary topics from mechanics, heat, electricity, sound, and light, emphasizing the use of basic principles to understand everyday experience. Includes practical problem exercises and a coordinated laboratory.

Phys 111. General Physics. (4-2) Cr. 4. F.S.SS. *Prereq:* *1½ years of high school algebra, 1 year of geometry, 1 semester of trigonometry.* General background in physical concepts, principles, and methods for those who do not plan advanced study in physics or engineering. Mechanics, fluids, heat and thermodynamics, vibrations, waves, sound. Materials fee.

Phys 112. General Physics. (4-2) Cr. 4. F.S.SS. *Prereq:* *111.* General background in physical concepts, principles, and methods for those who do not plan advanced study in physics or engineering. Electricity and magnetism, ray and wave optics, topics in modern physics. Materials fee.

Phys 198. Physics of Music. (2-2) Cr. 3. F. Introductory level course on sound for nonphysics majors. Properties of pure tones and harmonics; human perception of sound; room acoustics; scales; production, and analysis of musical by voice, string, woodwind, brass, and percussion instruments.

Phys 221. Introduction to Classical Physics I. (4.5-1) Cr. 5. F.S.SS. *Prereq:* *Credit or enrollment in Math 166.* For engineering and science majors. 3 hours of lecture each week plus 3 recitations and 1 laboratory every 2 weeks. Elementary mechanics including kinematics and dynamics of particles, work and energy, linear and angular momentum, conservation laws, rotational motion, oscillations, gravitation. Electric forces and fields. Electrical currents; DC circuits. Materials fee.
H. Honors. F.S.

Phys 222. Introduction to Classical Physics II. (4-2) Cr. 5. F.S.SS. *Prereq:* *221, Math 166.* 3 hours of lecture each week plus 1 recitation and 1 laboratory each week. Magnetic forces and fields: LR, LC, LCR circuits; Maxwell's equations; waves and sound; ray optics and image formation; wave optics; heat, thermodynamics, kinetic theory of gases; topics in modern physics. Materials fee.
H. Honors. F.S.

Phys 232. Computational Methods of Physics. (0-2) Cr. 1. S. *Prereq:* *222.* Techniques in the use of personal computers and workstations to solve physics-

related problems. Programming experience is helpful but not necessary.

Phys 290. Independent Study. Cr. 1 to 4 each time taken. *Prereq: Permission of instructor.*

Phys 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Phys 302. The Challenge of Contemporary Physics. (3-0) Cr. 3. S. *Prereq: Sophomore classification.* A largely nonmathematical but intellectually challenging exploration of physics which assumes no previous work in the field. Selected material from classical and modern physics establishes the conceptual framework for the study of a major area of contemporary physics, culminating in the discussion of topics at the frontier of present knowledge. Research topics may vary from year to year and may include new particles, quarks, superconductivity, lasers, nuclear fusion, liquid crystals, solid state devices, gravitational waves.

Phys 304. Thermal Physics. (3-0) Cr. 3. F. *Prereq: 222, Math 266.* Concepts of temperature, entropy, and other characteristic thermodynamic functions, with application to macroscopic properties of matter. The laws of thermodynamics. Introduction to statistical mechanics, including quantum statistics. Application to black body radiation, crystalline vibrations, magnetic ions in solids, electronic heat capacity of metals. Phase transformations and chemical reactions. Nonmajor graduate credit.

Phys 306. Physics of Wave Motion. (3-0) Cr. 3. S. *Prereq: 222, credit or enrollment in Math 267.* Oscillating systems including damped and forced oscillations; fluids, geometric optics, water waves, the wave equation, Fourier and Laplace transforms, non-uniform media, cylindrical and spherical waves, polarization, interference and diffraction, transmission lines, non-linear waves.

Phys 310. Electronic Instrumentation for Experimental Physics. (2-4) Cr. 4. F. *Prereq: 222; Math 166.* Common electrical instruments: power supplies; transducers: passive and active devices, analog integrated circuits, including filters and amplifiers; digital integrated circuits; signal transmission and enhancement. Nonmajor graduate credit.

Phys 311. Intermediate Laboratory. (0-3) Cr. 1 or (0-6) Cr. 2 each time taken. S. *Prereq: 322 or 324.* Experiments in classical and modern physics performed independently by each student. Nonmajor graduate credit.

Phys 311T. Intermediate Laboratory. (0-6) Cr. 3 each time taken. S. *Prereq: 112 or 222.* Experiments in classical and modern physics performed independently by each student. For students preparing for a career in high school teaching.

Phys 321. Introduction to Modern Physics I. (3-0) Cr. 3. S. *Prereq: 222, credit or enrollment in Math 266.* Quantum nature of matter: photons, Bohr model of hydrogen, deBroglie wavelength of matter. Schrödinger wave equation in one dimension: energy quantization; detailed solutions for potential steps, barriers and wells. One-electron atoms, spin, and transition rates; x-ray and optical excitations of multi-electron atoms.

Phys 321L. Introductory Laboratory in Modern Physics. (0-2) Cr. 1. S. *Prereq: Credit or enrollment in 321 and credit or enrollment in 232 or equivalent experience.* Experiments related to the foundations of modern physics. The dual wave and particle character of electrons and photons, statistics, interferometry and x-ray spectroscopy.

Phys 322. Introduction to Modern Physics II. (3-0) Cr. 3. F. *Prereq: 321.* Quantum statistics; lasers; physics of molecules. Properties of solids, including electron band structure, superconductivity and magnetism. Nuclear physics, including nuclear sizes and masses, stability, decay modes, reactions, fission and fusion. Elementary particles, including strangeness, charm, and quarks. Fundamental forces of nature.

Phys 322L. Introductory Laboratory in Modern Physics II. (0-2) Cr. 1. F. *Prereq: Credit or enrollment in 322.* Experiments related to the foundations of modern physics. Radioactive decay, elementary particles, Hall effect, spectroscopy and instrumentation.

Phys 324. Elementary Modern Physics. (3-0) Cr. 3. F.S. *Prereq: 222, credit or enrollment in Math 266.* For students desiring a one-semester introduction to modern physics following Phys 222; students desiring a more comprehensive treatment should consider Phys 321-322. Quantization of light and energy, Schrödinger equation, atomic physics, molecular structure and spectra, properties of solids, the nuclear atom, nuclear fission and fusion. Nonmajor graduate credit.

Phys 361. Classical Mechanics. (3-0) Cr. 3. F. *Prereq: 222, Math 265, 266.* Newtonian mechanics including forced oscillations, central forces and orbital motion, collisions, moving frames of reference, Lagrange's equations. Nonmajor graduate credit.

Phys 362. Intermediate Mechanics. (3-0) Cr. 3. S. *Prereq: 361.* Rigid body motion: small oscillations, normal modes. Special relativity including length contraction, time dilation, simultaneity, Lorentz transformation, 4-vector covariant formalism, relativistic mechanics. Nonmajor graduate credit.

Phys 364. Electricity and Magnetism I. (3-0) Cr. 3. S. *Prereq: 222, Math 385.* Static electric and magnetic fields, potential theory; electromagnetism, Maxwell's equations. Nonmajor graduate credit.

Phys 365. Electricity and Magnetism II. (2-0) Cr. 2. F. *Prereq: 364.* Relativistic electromagnetic theory; radiation and propagation of electromagnetic waves; interaction with matter. Nonmajor graduate credit.

Phys 389. Seminar (1-0) Cr. R. S. Required of all Junior physics majors. Career opportunities: graduate school programs and application, job placement, alternative careers, basic skills needed for the job market competition. Offered on a satisfactory-fail grading basis only.

Phys 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Phys 399. Seminar on Secondary School Physics. Cr. 1 to 2; maximum of 2. F.S. *Prereq: Permission of instructor.* Review of materials and curricula for secondary school physics presented and discussed by members of the class. Required for approval to teach physics in secondary schools.

Phys 450. Undergraduate Research. Cr. 1 to 6 each time taken. F.S.SS. *Prereq: Permission of instructor.* Theoretical research under supervision of physics faculty.

Phys 450L. Undergraduate Research. Cr. 1 to 6 each time taken. F.S.SS. *Prereq: 311, permission of instructor.* Laboratory project under supervision of physics faculty.

Phys 470L. Applied Physics Laboratory. Cr. 2-5 each time taken. F.S.SS. *Prereq: 322 or 324 and permission of instructor.* Studies in modern experimental techniques via experimentation and simulation in various areas of applied physics, e.g. superconductivity, optical spectroscopy, nuclear magnetic resonance, electron spin resonance, x-ray diffraction, and computation of electronic and structural properties of matter.

Phys 480. Quantum Mechanics. (3-0) Cr. 3. F. *Prereq: 322, Math 385.* A systematic development of quantum mechanics, including differential and operator solutions of the time-dependent Schrödinger equation in one through three dimensions, Heisenberg equations of motion, Dirac notation, time-independent perturbations, angular momentum, the hydrogen atom, and quantum paradoxes. Nonmajor graduate credit.

Phys 481. Applied Quantum Mechanics. (3-0) Cr. 3. S. *Prereq: 480.* Charged particles in electromagnetic fields, spin and matrix mechanics, angular momentum, approximation methods, time-dependent perturbations, collision theory, selected topics from radi-

ation theory, Fermi and Bose gases, interpretation of quantum mechanics. Nonmajor graduate credit.

Phys 489. Tutorial Seminar. (1-0) Cr. 1 each time taken. F.S. *Prereq: Permission of instructor.* For junior and senior physics majors. Topics of interest in physics discussed in small groups. Offered on a satisfactory-fail grading basis only.

Phys 490. Independent Study. Cr. 1 to 4. *Prereq: 6 credits in physics, permission of instructor.* No more than 9 credits of Phys 490 may be counted toward graduation.
H. Honors

Phys 496. Modern Optics. (3-0) Cr. 3. S. *Prereq: Credit or enrollment in 321 and 365.* Review of wave and electromagnetic theory; topics selected from: reflection/refraction, interference, geometrical optics, Fourier analysis, dispersion, coherence, Fraunhofer and Fresnel diffraction, holography, quantum optics, nonlinear optics. Nonmajor graduate credit.

Phys 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Phys 500. Introductory Research Seminar. (1-1) Cr. R. F. Discussion by research staff of their research areas, expected thesis research work, and opportunities in the field. For graduate physics majors only. Offered on a satisfactory-fail grading basis only.

Phys 501. Oral Communication of Physics Seminar. (2-0) Cr. 1 each time taken. F. *Prereq: Graduate classification.* Practice in communication of physics and astronomy in typical college classroom settings and professional meetings. Skills emphasized include selection of physical examples and analogies, presentation styles of topics, scientific dialogue, organization of physics topics, and classroom technique. The teaching proficiency of each student is evaluated in detail. For graduate physics majors only. Offered on a satisfactory-fail grading basis only.

Phys 511. Solid State Physics. (3-0) Cr. 3. S. *Prereq: 304, 322.* First semester of a full-year course. Free electron model; crystal symmetry; band theory of solids; transport properties; Fermi surface; phonons; semiconductors; crystal surfaces; magnetism; superconductivity.

Phys 512. Solid State Physics. (3-0) Cr. 3. F. *Prereq: 511.* Continuation of 511. Free electron model; crystal symmetry; band theory of solids; transport properties; Fermi surface; phonons; semiconductors; crystal surfaces; magnetism; superconductivity.

Phys 515. Physical Processes in Plasma. (Same as E E 515.) See *Electrical Engineering*.

Phys 524. Nuclear Physics. (3-0) Cr. 3. S. *Prereq: 480.* Basic properties and structure of atomic nuclei, introduction to nuclear models, nuclear reactions, decay and stability; accelerators; nuclear astrophysics and nuclear physics at the quark-gluon level.

Phys 528. Atmospheric Physics. (Same as Mteor 528.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 304, 322, 361, and 364.* Physics of fluids as applied to the atmosphere: equations of motion, conservation laws; atmospheric waves, small to planetary scale; remote sensing by satellites.

Phys 531. Statistical Mechanics. (3-0) Cr. 3. F. *Prereq: 304, Math 465, credit or enrollment in Math 365 or 426.* Thermodynamic properties of systems of many particles obeying Boltzmann, Fermi-Dirac, and Bose-Einstein statistics; microcanonical, canonical, and grand canonical ensembles and their application to physical problems; density matrices; introduction to phase transitions; renormalization group theory; kinetic theory and fluctuations.

Phys 535. Physics of Semiconductors. (Same as E E 535.) See *Electrical Engineering and Computer Engineering*.

Phys 536. Physics of Semiconductor Devices. (Same as E E 536.) See *Electrical Engineering and Computer Engineering*.

Phys 537. High Energy Physics. (3-0) Cr. 3. S. *Prereq:* 480. Survey of particle physics: covariant kinematics and Lagrangians; the Standard Model and the Higgs mechanism, W^+ and Z^0 production and decay; hadron spectroscopy, structure functions; running coupling constants; the CKM matrix; selected topics beyond the Standard Model such as supersymmetry and grand unification.

Phys 541. General Relativity. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 362 or Math 465. Tensor analysis and differential geometry developed and used to formulate Einstein field equations. Schwarzschild and Kerr solutions. Other advanced topics may include gravitational radiation, particle production by gravitational fields, alternate gravitational theories, attempts at unified field theories, cosmology.

Phys 551. Computational Physics. (0-4) Cr. 2. S. *Prereq:* 365, 480. Use of modern computational techniques to analyze topics in classical and modern physics. Offered on a satisfactory-fail grading basis only.

Phys 564. Advanced Classical Mechanics. (3-0) Cr. 3. F. *Prereq:* 361, Math 426, 465. Variational principles, Lagrange's equations, Hamilton's canonical equations, canonical transformations, Hamilton-Jacobi theory, infinitesimal transformations, classical field theory.

Phys 571. Advanced Electricity and Magnetism. (3-0) Cr. 3. F. *Prereq:* 365, Math 426. Electrostatics, magnetostatics, boundary value problems, Maxwell's equations, wave phenomena in macroscopic media, wave guides.

Phys 572. Advanced Electricity and Magnetism. (3-0) Cr. 3. S. *Prereq:* 571. Special theory of relativity, least action and motion of charged particles in electromagnetic fields, radiation, collisions between charged particles, multipole fields, radiation damping.

Phys 590. Special Topics. Cr. var. *Prereq:* Permission of instructor. Topics of current interest.

- Nuclear Physics
- Condensed Matter Physics
- High Energy Physics
- Physics
- Applied Physics

Phys 591. Quantum Physics. (4-0) Cr. 4. S. *Prereq:* 480. First semester of a full-year course. Time-dependent and time-independent Schrödinger equations for one-, two-, and three-dimensional systems; bound systems; methods of quantum scattering; linear vector spaces; angular momentum theory and intrinsic spin; perturbation methods; identical particles and exchange effects; symmetries; applications in physics and chemistry.

Phys 592. Quantum Physics. (4-0) Cr. 4. F. *Prereq:* 591. Continuation of 591. Time-dependent and time-independent Schrödinger equations for one-, two-, and three-dimensional systems; bound systems; methods of quantum scattering; linear vector spaces; angular momentum theory and intrinsic spin; perturbation methods; identical particles and exchange effects; symmetries; Dirac and Klein-Gordon equations; applications in physics and chemistry.

Phys 599. Creative Component. Cr. var. *Prereq:* Permission of instructor. Individually directed study of research-level problems for students electing the thesis M.S. degree option.

Courses for Graduate Students

Phys 611. Quantum Theory of Condensed Matter. (3-0) Cr. 3. S. *Prereq:* 512, 681. Quasiparticles in condensed matter: phonons, magnons, photons, electrons. Quantum theory of interacting many body systems: Green's functions and diagrammatic techniques.

Phys 624. Advanced Nuclear Physics I. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 524 and 592. Microscopic few-body and many-body theory; theory of effective Hamiltonians; relativistic nuclear physics; high-energy hadron-nucleus, lepton-nucleus, and nucleus-nucleus reactions.

Phys 625. Advanced Nuclear Physics II. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 624. Quantum field theory applied to nuclear structure and reactions; tests of the Standard Model in nuclei; phase transitions in hot and dense hadronic matter; quark-gluon plasma.

Phys 632. Semiconductor Physics. (Same as E E 632.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 480, 481, 511. Band structure; statistical mechanics of electrons and holes; galvanic-magnetic effects, magnetoresistivity, cyclotron resonance; transport properties; principles of junctions and heterostructures; optical properties; amorphous semiconductors; quantum well structures.

Phys 637. Elementary Particle Physics. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 637. First semester of a full year course. Properties of leptons, bosons, and quarks and their interactions; quantum chromodynamics, Glashow-Weinberg-Salam model, grand unification theories, supersymmetry; modern theoretical techniques and tests of the Standard Model.

Phys 638. Elementary Particle Physics. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 637. Continuation of 637. Properties of leptons, bosons, and quarks and their interactions; quantum chromodynamics, Glashow-Weinberg-Salam model, grand unification theories, supersymmetry, and superstring theory; modern theoretical techniques.

Phys 650. Advanced Seminar. (1-0) Cr. 1 each time taken. F.S. Topics of current interest. Offered on a satisfactory-fail grading basis only.

- Nuclear Physics
- Condensed Matter Physics
- High Energy Physics
- Physics
- Applied Physics

Phys 660. Advanced Topics in Physics. Cr. 1 to 3 each time taken. F.S. Courses on advanced topics and recent developments.

- Nuclear Physics
- Condensed Matter Physics
- High Energy Physics
- Physics
- Applied Physics

Phys 674. Applications of Group Theory to Physics: Condensed Matter Physics. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 592. Theory of groups and group representations; point, space, and rotation groups; applications to molecular and crystal structures, crystal field and spin-orbit interactions, energy bands and phonon dispersion relations. Applications to modern materials.

Phys 675. Applications of Group Theory to Physics: Nuclear and High Energy Physics. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 592. Theory of Lie groups, Lie algebras, and their representations. Survey of the Lorentz group, Poincaré group, SU(N), and other Lie groups of physical importance. Applications to nuclear and elementary particle physics.

Phys 681. Advanced Quantum Mechanics. (3-0) Cr. 3. S. *Prereq:* 592. Dirac equation and relativistic quantum mechanics, propagator theory, Feynman diagrams; quantum electrodynamics, Klein-Gordon equation.

Phys 682. Quantum Field Theory. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 681. Field quantization, Feynman rules, radiative corrections; introduction to renormalization.

Phys 699. Research.

Undergraduate Study

For undergraduate major in plant health and protection leading to the degree bachelor of science, see *Agriculture, Curricula*.

Plant Health and Protection is an interdepartmental major administered by the departments of Plant Pathology, Entomology, Agronomy, Horticulture, and Forestry. The program emphasizes a holistic approach to plant health maintenance encompassing soil fertility and plant nutrition, genetics and plant breeding, cultural practices, and protection from pests such as insects, weeds, and the microorganisms that cause plant diseases. Graduates understand the principles of plant structure and function and the ways in which plants are affected by biotic and abiotic stress factors. They are skilled in diagnosing plant health problems and in developing and implementing plant health management strategies to reduce plant stress with minimal environmental impact. Graduates are able to communicate clearly and work effectively with others on complex plant health problems. They understand the ethical and environmental dimensions of problems and issues facing agricultural and natural resource professionals.

Plant Health and Protection is a broad-based curriculum in biological and agricultural sciences. Students take courses in the basic biological and physical sciences, plant fertility management, entomology, weed science, plant pathology, and plant production systems (agronomy, horticulture, and forestry). Cooperative practical work experience/internships with industry and governmental agencies are available to qualified students. Students also have a large number of free elective credits for courses that they can use to individualize their degree program.

Plant health professionals are employed by agribusiness firms such as seed companies, agricultural chemical companies, farm management and crop consulting businesses, producer cooperatives, food processors, greenhouses, nurseries, and landscape businesses. Graduates are also employed by governmental agencies like the EPA, USDA, Extension Service, and state departments of agriculture. The curriculum in plant health and protection provides an excellent preparation for graduate study in the crop protection disciplines and related fields such as agronomy, horticulture, plant breeding, genetics, microbiology, molecular biology, botany, and environmental science.

A minor in plant health and protection may be earned with 15 or more credits in 206, 391 and additional courses selected from an approved list available from the chair of the Plant Health and Protection advisory committee. At least 9 of the 15 credits may not be used to satisfy other department, college, or university requirements.

Courses open for nonmajor graduate credit: 301, 354, 376, 407, 416, 420.

Courses Primarily for Undergraduate Students

PI HP 110. Orientation in Plant Health and Protection. (1-0) Cr. R. F. *Prereq:* Required of students in the plant health and protection curriculum.

Plant Health and Protection

www.plantpath.iastate.edu

Interdepartmental Undergraduate Program)

Advisory Committee: Ed Braun, Chair; Burras, Hart, Martinson, Taber, Wray

Requirements and career opportunities in the fields of plant health and protection.

PI HP 206. Plant Health Biology. (3-0) Cr. 3. S. *Prereq: Biol 109 or 201.* Introduction to issues in plant health biology: plant productivity and food supply, soils and plant health, plant biotechnology, integrated pest management, plant health and sustainable agriculture.

PI HP 283. Pesticide Application Certification. (Same as Ent 283.) See *Entomology*.

PI HP 301. Forest Ecology. (Same as For 301.) See *Forestry*. Nonmajor graduate credit.

PI HP 317. Principles of Weed Science. (Same as Agron 317.) See *Agronomy*.

PI HP 354. Soils and Plant Growth. (Same as Agron 354.) See *Agronomy*. Nonmajor graduate credit.

PI HP 354L. Soils and Plant Growth Laboratory. (Same as Agron 354L.) See *Agronomy*.

PI HP 376. Fundamentals of Entomology and Pest Management. (Same as Ent 376.) See *Entomology*. Nonmajor graduate credit.

PI HP 391. Practical Plant Health. (Same as PI P 391.) (0-4) Cr. 2. F. *Prereq: 6 credits in biological sciences.* Diagnosis of all types of plant health problems caused by diseases, insects, weeds, fertility, herbicide injury, and environmental stress. Emphasis is on acquiring practical skills. Experience in written and oral communications. Field trips.

PI HP 392. Plant Health and Protection Work Experience. Cr. R. F.S.S.S. *Prereq: 6 credits in plant health and protection, permission of advisor.* Practical work experience in a plant health discipline. For majors and advanced students.

PI HP 407. Principles of Plant Pathology. (Same as PI P 407.) See *Plant Pathology*. Nonmajor graduate credit.

PI HP 416. Forest Pest Management. (Same as PI P 416.) See *Plant Pathology*. Nonmajor graduate credit.

PI HP 420. Plant Nutrition. (Same as Hort 420.) See *Horticulture*. Nonmajor graduate credit.

PI HP 475. Community Tree Management. (Same as For 475.) See *Forestry*.

PI HP 491. Independent Study. Cr. 1 to 3. F.S.S.S. *Prereq: Junior or senior classification, 6 credits in plant health and protection, permission of instructor.* A maximum of 6 credits of 490 may be used toward the total of 128 credits required for graduation.
A. Plant Health and Protection
H. Honors

PI HP 498. Plant Health Management. (1-6) Cr. 3. F. *Prereq: 391.* Problem-solving skills in plant health and protection through study of case histories and actual problems submitted by clients in the field. Group dynamics and communication skills stressed.

Plant Pathology

www.plantpath.iastate.edu

Edward J. Braun, Chair of Department

Distinguished Professors: Tiffany

University Professors: McNabb

Professors: Braun, Epstein, Gleason, Harrington, Hill, Hodges, McGe

Professors (Collaborators): Stuckey

Distinguished Professors (Emeritus): Isely

Professors (Emeritus): Durand, Everson, Norton, Stewart

Associate Professors: Bronson, Martinson, Miller, Munkvold, Nutter, Tylka

Associate Professors (Collaborators): Wise

Assistant Professors: Baum, Beattie, Yang

www.plantpath.iastate.edu

Undergraduate Study

The department participates in the undergraduate major and minor in plant health and protection; see *Agriculture, Curricula*.

For a second major in pest management see *Agriculture, Curricula*.

Graduate Study

The department offers studies for the degrees master of science and doctor of philosophy with a major in plant pathology, and minor work for students majoring in other departments or programs. A master of science non-thesis option is available. The department also participates in the inter-departmental majors in toxicology; genetics; plant physiology; and molecular, cellular, and developmental biology.

Students entering graduate programs in the department need a sound background in the physical, biological, and mathematical sciences as well as adequate preparation in English.

Graduates have a broad understanding of the biology and management of plant pathogenic microorganisms and the interactions of pathogens with their host plants. They understand the relationship between plant pathology and allied disciplines and are able to communicate effectively with scientific colleagues and the general public in both formal and informal settings. Graduates are able to address complex plant disease problems facing agricultural and bioscience professionals, taking into account the related ethical, social, legal, and environmental issues. They are skilled in research procedures, communicating research results, and writing concise and persuasive grant proposals.

Courses open for nonmajor graduate credit: 407, 416, 483, 493.

Courses Primarily for Undergraduate Students

PI P 391. Practical Plant Health. (Same as PI HP 391.) See *Plant Health and Protection*.

PI P 407. Principles of Plant Pathology. (Same as PI HP 407, P M 407.) (2-3) Cr. 3. F.S. *Prereq: 8 credits in biological sciences, including Biol 202.* Braun. Principles underlying the nature, diagnosis, and management of plant diseases. Laboratory complements lecture topics and provides experience in plant disease diagnosis. Nonmajor graduate credit.

PI P 416. Forest Pest Management. (Same as Ent 416, For 416, PI HP 416, P M 416.) (3-3) Cr. 4. S. *Prereq: 8 credits in biological sciences, including Biol 201.* Harrington, Hart. Nature of forest, shade tree, and wood pests; physical agents of tree damage; concepts of forest health; integrated case studies in the evaluation and economic analysis of protection and pest management problems; weekend field trip. Field trip fee. Nonmajor graduate credit.

PI P 452. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 552; same as Ent 452, Hort 452.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: Hort 351.* Gleason, Lewis D. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

PI P 477. Bacterial-Plant Interactions. (Dual-listed with 577; same as Micro 477.) (3-0) Cr. 3. Alt. S.,

offered 2000. *Prereq: 3 credits in microbiology or plant pathology.* Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interactions with plants.

PI P 483. Wood Deterioration and Preservation. (Same as For 483.) See *Forestry*. Nonmajor graduate credit.

PI P 490. Independent Study. Cr. 1 to 3. F.S.S.S. *Prereq: Junior or senior classification, 7 credits in biological sciences, permission of instructor.* A maximum of 6 credits of 490 may be used toward the total of 128 credits required for graduation.
A. Plant Pathology
H. Honors

PI P 493. Practical Plant Pathology. Cr. 1. (40-hour workshop.) *Prereq: 6 credits in biological sciences.* Team-taught. Introduction to the characteristics and ecology of plant diseases caused by fungi, bacteria, nematodes, and viruses. Emphasis is on practical knowledge and hands-on experiences geared to the interests of agribusiness, horticultural, and extension professionals. Materials fee. Offered on a satisfactory-fail grading basis only. Nonmajor graduate credit.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

PI P 503. Biology of Plant Pathogens. (3-3) Cr. 4. F. *Prereq: Biol 202, Biol 301.* Braun, Hill, Martinson, Tylka. Biology, ecology, and taxonomy of organisms that cause plant disease. Laboratory experience emphasizes techniques in working with fungi, bacteria, nematodes, and viruses. Field trips.

PI P 506. Plant-Pathogen Interactions. (2-0) Cr. 2. S. *Prereq: 407 or 416 or 503, Biol 301.* Baum, Bronson. Genetics of disease resistance and pathogenicity. Introduction to mechanisms of plant-parasite interaction.

PI P 507. Epidemiology and Disease Management. (2-0) Cr. 2. S. *Prereq: 407 or 416 or 503.* Martinson, Nutter. Principles of pathogen population dynamics as affected by environment and host genetics. Utilization of epidemiological principles for disease management; gene management strategies.

PI P 509. Plant Virology. (Same as Micro 509.) (2-6) Cr. 4. Alt. S., offered 2001. *Prereq: 407 or 503, Bot 404, BBMB 405, Chem 211.* Hill. Plant viruses and the diseases they cause. Emphasis on epidemiology and control. Structure, function, and biochemical-bio-physical properties of plant viruses.

PI P 543. Plant Disease Epidemiology. (2-4) Cr. 4. Alt. F., offered 2000. *Prereq: 407 or 416 or 503.* Nutter. Analysis of genetic, environmental, and disease management factors that alter the course of plant disease epidemics. Laboratory emphasizes techniques for quantitative measurement and modeling of epidemics.

PI P 552. Integrated Management of Diseases and Insect Pests of Turfgrasses. (Dual-listed with 452; same as Ent 552, Hort 552.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: Hort 351.* Gleason, Lewis D. Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

PI P 574. Plant Nematology. (2-3) Cr. 3. Alt. F., offered 2000. *Prereq: 407 or 416 or 503.* Baum. Morphology, anatomy, identification, control, and life cycles of common plant-parasitic nematodes; host-parasite interactions; *Caenorhabditis elegans*.

PI P 577. Bacterial-Plant Interactions. (Dual-listed with 477; same as Micro 577.) (3-1) Cr. 3. Alt. S., offered 2000. *Prereq: 3 credits in microbiology or plant pathology.* Focuses on plant-associated bacteria in terms of their ecology, diversity, and the physiological and molecular mechanisms involved in their interactions with plants.

PI P 590. Special Topics. Cr. 1 to 3 each time taken. F.S.S.S. *Prereq: 10 credits in biological sciences, permission of instructor.*

PI P 591. Plant Disease Control. (2-3) Cr. 3. Alt. F., offered 1999. *Prereq: 407 or 416 or 503.* Martinson.

Principles and practices of disease control. Use of biological control, cultural practices, resistance and chemical control in disease management.

PI P 594. Seed Pathology. (2-3) Cr. 3. Alt. S., offered 2001. *Prereq:* 407 or 503. McGee. Significance of diseases on the major phases of seed production; growing, harvesting, conditioning, storing, and planting seed. Pathogens considered include fungi, bacteria, viruses, nematodes, and abiotic agents. Emphasis on control, epidemiology, host-parasite relationships, and seed health testing.

Courses for Graduate Students

PI P 608. Molecular Virology. (Same as V MPM 608.) See *Veterinary Microbiology and Preventive Medicine*.

PI P 691. Field Plant Pathology. (0-6) Cr. 2 each time taken. Alt. SS., offered 2000. *Prereq:* 407 or 416 or 503. Diagnosis of plant diseases, plant disease assessment methods, and the integration of disease management into commercial crop production practices. Objectives are to familiarize students with common diseases of Midwest crops and landscape plants, and to provide experience in disease diagnosis. Field trips include commercial operations, agricultural research facilities, and ornamental plantings.

PI P 692. Molecular Biology of Plant-Pathogen Interactions. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 506 or BBMB 405 or Gen 411 or Micro 402 or course in molecular biology. Miller. Molecular and physiological mechanisms of plant disease and resistance. Host-pathogen recognition and response, resistance gene function, signal transduction, *Agrobacterium*, virus-host interactions.

PI P 694. Colloquium in Plant Pathology. (2-0) Cr. 2 each time taken. F.S. *Prereq:* 407 or 416 or 503, permission of instructor. Advanced topics in plant pathology, including biological control, cultural control, risk assessment of resistance gene deployment, genetic engineering for disease resistance, chemical control, tropical diseases, fungal genetics, and professional communications.

PI P 698. Seminar. Cr. 1 each time taken. F.S.

PI P 699. Thesis and Dissertation Research. Cr. var. F.S.SS.

Plant Physiology

(Interdepartmental Graduate Major)

Supervisory Committee: M. H. Spalding, Chair; J. Burris, J. T. Colbert, W. R. Graves, B. Nikolau

Work is offered for the degrees master of science (thesis option only) and doctor of philosophy with a major in plant physiology in the following participating departments: Agronomy; Biochemistry, Biophysics and Molecular Biology; Botany; Forestry; Horticulture; Plant Pathology; and Zoology and Genetics. In the Interdepartmental Plant Physiology Major at Iowa State University, students use modern, interdisciplinary approaches to understand plant processes at the molecular, cellular and whole-plant levels. Graduates have a broad understanding of basic, functional plant biology with emphases on fundamental biology, biochemistry, and molecular biology. They are able to address complex research and policy problems in agriculture, biotechnology, and basic plant biology.

All M.S. students must meet the following minimum requirements: (1) enroll each term and make one presentation each year in the interdepartmental plant physiology seminar (Bot 696 or its cross-listed equivalents); (2) complete two courses chosen from the following: Bot 511, 512, 513; and (3) complete the

following courses: BBMB 404 and 405 or 501 and 502; and Stat 401. A course in physical or biophysical chemistry is recommended.

All Ph.D. students must complete the following requirements, in addition to those for the M.S.: Bot 511, 512, 513; one course chosen from Bot 545, Gen 511, or Gen 520; one course chosen from BBMB 411, 511, Bot 583; and one course in physical or bio-physical chemistry (BBMB 451 for example). Stat 402 is recommended.

In consultation with his or her major professor and the POS committee, a student may select additional courses from an approved list available from the chair of the supervisory committee of the interdepartmental major.

Courses for Graduate Students

P Phy 511. Plant Nutrition and Water Relations. (Same as Bot 511.) See *Botany*.

P Phy 512. Plant Growth and Development. (Same as Bot 512.) See *Botany*.

P Phy 513. Plant Metabolism. (Same as Bot 513.) See *Botany*.

P Phy 545. Plant Molecular Biology. (Same as Bot 545.) See *Botany*.

P Phy 696. Seminar in Plant Physiology and Molecular Biology. (Same as Bot 696.) See *Botany*.

Political Science

James M. McCormick, Chair of Department

Distinguished Professors: Sandler

University Professors: Schmidt

Professors: Dearin, James, Kihl, Lee, Maney, Mansbach, McCormick, Moses, Shelley, Smith, Tetreault

Distinguished Professors (Emeritus): Rasmussen

Professors (Emeritus): Boles, Parks, Talbot

Associate Professors: Coates, Dobratz, Hutter, Rahm, Rice, Van Wart

Associate Professors (Emeritus): Whitmer

Assistant Professors: Clark-Daniels, Dombrowski, Duffy, Ho

Assistant Professors (Adjunct): Waggoner

Assistant Professors (Emeritus): Shakeshaft

Undergraduate Study

For the undergraduate curriculum in Liberal Arts and Sciences, with major in political science, leading to the degree of bachelor of arts, see *Liberal Arts and Sciences, Curriculum*.

The study of political science is designed to enable students to become familiar with theories of public values and patterns of political systems—national, regional, and international. A political science major should complete a broad liberal arts program, which would maximize opportunities for study in related social science disciplines, as well as in various areas of the humanities. Graduates understand the basic principles, concepts, and methods of the discipline and should be able to apply them. They are familiar with theories of public values and patterns of political systems and understand the interrelationships of the subdisci-

plines of political science. They also develop skills in analysis and critical thinking and are able to apply research methods relevant to the discipline.

Each student majoring in political science will develop a research tool. This requirement may be met by either successful completion of two years of foreign language or completion of Pol S 301.

To be certified for the LAS English proficiency requirement, political science majors must earn at least a C+ in both Engl 104 and 105. Those who do not must enroll in Engl 309 or 314 and earn at least a C.

The political science major has the opportunity to participate in the Washington Center internship program. The student may gain academic credit and first-hand experience through either a governmental, non-profit, or private sector internship in Washington, D.C. in this program. Up to 12 academic credits may be earned. A complete description of the program is available from the department office.

Students majoring in political science may earn a second major in international studies in the College of Liberal Arts and Sciences. See *International Studies*.

The political science major is often used by students preparing for a career in law. Interested students with this goal should consult with the department in selecting courses. See also *Preprofessional Study*.

The department offers a minor in political science, which may be earned by completing 15 credits beyond the 100-level of coursework in political science, nine of which must be at the 300 level or above. A full statement of requirements and limitations is available from the department office.

A political science minor has been used by many students with majors in other disciplines. The availability of the minor is noted because so many occupations and activities are affected by politics and governmental activity.

Graduate Study

The department offers work for the master of arts degree (M.A.), with a major in political science, and minor work for students majoring in other departments.

The M.A. program is designed to enable its graduates to engage in governmental research, enter public service or private industry, pursue further graduate study, or teach. A thesis is required for this degree. A specialization in public administration is possible. The department also has a joint master of arts/juris doctor (M.A./J.D.) program with the Law School of Drake University. In addition, graduate students may wish to work for certification for high school or junior college teaching.

The department also offers a master of public administration (M.P.A.) degree and a Certificate of Public Management (CPM). The former is a professional degree designed to provide interested students with the training necessary to work within a public bureaucracy or organization. The M.P.A. degree requires 39

semester credit hours. The CPM is especially designed for current public administrators who do not wish to complete the M.P.A. It requires 15 semester credit hours.

Brochures setting forth detailed requirements for all graduate degrees may be obtained from the department office.

Graduates have a broad substantive understanding of the political process and the academic study of politics. They also have in-depth knowledge of one or more subfields in political science. Public Administration graduates are qualified to hold managerial and administrative positions in government (federal, state, and local) and not-for-profit organizations.

Graduates are skilled at conducting research and preparing thorough research summaries. They are able to identify and address complex political questions, taking into account related ethical, legal, economic, and social issues.

A usual prerequisite for major graduate work in the department is the completion of at least 15 semester credits in political science. The Graduate Record Examination (verbal and quantitative portions) is required.

Each student entering the master of arts program in political science is expected to have completed one year of a foreign language (equivalent to 8 semester credits) and a course in basic statistics (equivalent to Stat 101). If this has not been done, the student may remedy the deficiency by passing equivalent courses, for which no graduate credit will be received.

In addition, each student must complete one of the following requirements:

1. Language—Two years of undergraduate instruction (including the one year of foreign language provided above) in a single language, with grades averaging 2.7 (on a 4.0 scale); or, a passing grade in the Educational Testing Service examination.

2. Statistics—Successful completion of Stat 401. Stat 404 is recommended, but not required.

These are the minimum requirements. The student's program of study committee will decide if additional work, in either language or statistics, is necessary.

The department cooperates in the interdepartmental program in industrial relations, interdepartmental majors in transportation and water resources, and an interdepartmental minor in gerontology (see *Index*).

Courses open for nonmajor graduate credit: 370, 405, 406, 410, 413, 417, 420, 421, 422, 430, 431, 433, 440, 443, 451, 452, 453, 470, 471, 475, 476, 477, 478, 480, 482, 484, 486.

Refer to the Schedule of Classes or consult the department for up-to-date scheduling information.

Courses Primarily for Undergraduate Students

Pol S 101. Orientation to Political Science. (2-0) Cr. 1. 8 weeks, F.S. *Prereq: Political Science and Open Option majors only or permission of the instructor.* Introduction to the discipline and sub-fields of Political Science, including an introduction to analytical thinking, computing, and research skills relevant to politi-

cal science. Orientation to university, college, and departmental structure, policies, and procedures; student roles and responsibilities; degree planning and career awareness. Offered on a satisfactory-fail grading basis only.

Pol S 215. American Government: Institutions and Policies. (3-0) Cr. 3. F.S. Fundamentals of American democracy; constitutionalism; nature of federalism; rights and duties of citizens; institutions and processes of the executive, legislative, and judicial branches of government; role of public opinion, interest groups, and political parties. Policies and problems of national government.

Pol S 230. Introduction to Law and Politics. (3-0) Cr. 3. F.S. A general introduction to the basic concepts and theories of the state and of law, including such philosophic issues as authority, power, legitimacy, freedom, and political obligation. Readings from theories in political philosophy, jurisprudence, constitutionalism, and related areas of thought.

Pol S 241. Introduction to Comparative Government and Politics. (3-0) Cr. 3. F.S. Basic concepts and major theories; application to selected political systems, including non-western and communist political systems.

Pol S 251. Introduction to International Politics. (3-0) Cr. 3. F.S. Dynamics of interstate relations pertaining to nationalism, the nation state; peace and war; foreign policy making; the national interest; military capability and strategy; case studies of transnational issues, such as population, food, energy, and terrorism.

Pol S 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Pol S 301. Introduction to Empirical Political Research. (3-2) Cr. 4. F.S. *Prereq: 3 credits in political science; Stat 101 recommended.* Techniques of empirical political research and analysis; surveys; methods of data collection; applications of statistics and computer techniques.

Pol S 305. Political Behavior. (3-0) Cr. 3. F. *Prereq: Sophomore classification.* Empirical theories and descriptions of political behavior, including decision-making, voting, opinion and attitudes of both the public and political elites.

Pol S 306. Political Decision-Making and Conflict Resolution. (3-0) Cr. 3. Alt. yr. *Prereq: 3 credits in political science.* Study of domestic and international political conflict in both quasi-historical and hypothetical scenarios by means of simulation and gaming. Utility of simulation as a heuristic device; factors influencing the decision-making process through which conflict is resolved.

Pol S 307. Political Psychology. (3-0) Cr. 3. S. Examines political concepts (e.g. political leadership, war and peace) using models drawn from biology and personality, behavioral, and social psychology. Provides frameworks for discussing and analyzing the etiology of political behavior.

Pol S 310. State and Local Government. (3-0) Cr. 3. S. *Prereq: 3 credits in political science.* Role of state and local governments in the American federal system. Structures of participation: political parties, elections, interest groups. Major governmental institutions: legislative, executive, and judicial. Structure and functions of local governments.

Pol S 311. Municipal Government and Politics. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: 215.* Legal position of municipal corporation; forms of organization; administration of municipal services; problem-solving in municipal government; urban and metropolitan political process; implications of federal urban policies.

Pol S 312. Minicourse in American Government and Politics. (3-0) Cr. 2. 8 weeks. F.S. *Prereq: Sophomore classification.* Half-semester courses on significant topical issues in American government and politics. Designated repeat not permitted. Use of

credit in Pol S major and minor is limited; see department for information.

Pol S 313. Minicourse in Theory and Methods. (3-0) Cr. 2. 8 weeks. F.S. *Prereq: Sophomore classification.* Half-semester course on significant topical issues in theory and methods in political science. Designated repeat not permitted. Use of credit in Pol S major and minor is limited; see department for information.

Pol S 314. Minicourse in Comparative Politics. (3-0) Cr. 2. 8 weeks. F.S. *Prereq: Sophomore classification.* Half-semester course on significant topical issues in comparative politics. Designated repeat not permitted. Use of credit in Pol S major and minor is limited; see department for information.

Pol S 315. Minicourse in International Relations. (3-0) Cr. 2. 8 weeks. F.S. *Prereq: Sophomore classification.* Half-semester course on significant topical issues in international relations. Designated repeat not permitted. Use of credit in Pol S major and minor is limited; see department for information.

Pol S 320. American Judicial Process. (Same as C J St 320.) (3-0) Cr. 3. S. *Prereq: 215.* The genesis, structure, processes, and personnel of American courts; basic juridical concepts; restraints on exercise of the judicial power; major eras of American constitutional history; an overview of civil liberties; impact of court decisions on public policy.

Pol S 340. Politics of Developing Areas. (3-0) Cr. 3. Alt. S., offered 2000. Analysis of indices of underdevelopment as they relate to the political process of developed states. Impact of social and technological change on political systems of developing areas. Some case studies.

Pol S 341. Politics of Japan. (3-0) Cr. 3. Alt. S., offered 2000. Political traditions and cultures. Contemporary governmental structures and processes. Examination of public policy issues in Japan as a post-industrial society.

Pol S 342. Politics of China. (3-0) Cr. 3. Alt. F., offered 2000. The Chinese Revolution: origins, political theory and practice, party and government. China as a modernizing nation including the problems of leadership succession and economic transformation.

Pol S 343. Latin American Government and Politics. (3-0) Cr. 3. Alt. yr. Political institutions, processes, and contemporary issues. Selected countries examined intensively to illustrate generalizations. Role of parties, military, church, interest groups, and ideology.

Pol S 344. Public Policy. (3-0) Cr. 3. S. How political agendas come to be set in public policy, the politics of the policy-making process, political forces molding policy choices and the impact of such choices. The major areas of regulation, social policy, fiscal, and planning.

Pol S 345. British Politics. (3-0) Cr. 3. F. Social and cultural context of British politics. Parties, elections, and governmental structures. Substance and process of public policies in selected problem areas.

Pol S 346. Governments of Western Europe. (3-0) Cr. 3. S. Comparative study of political institutions of France, Germany, and Italy; emphasis on parties, elections, and governmental structures. Substance and process of public policies in selected problem areas.

Pol S 347. Introduction to African Politics. (3-0) Cr. 3. Alt. yr. Traditional political cultures of sub-Saharan Africa, colonial regimes and rise of nationalism, modern political processes and institutions, illustrations from various parts of sub-Saharan Africa.

Pol S 348. Israeli Government and Politics. (3-0) Cr. 3. S. *Prereq: 241 or comparable background in Middle East/Israeli history.* Major factors that have shaped and continue to influence the distinctive nature of Israeli society and politics. Patterns and determinants of Mideast international relations, as reflected in Arab-Israeli conflict, foreign policymaking in Israel, and American involvement since 1945.

Pol S 349. Politics of Russia and Central Eurasia. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: 241 or comparable background in Soviet/Russian history.* Nation-

states of the former Soviet Union. Analysis of Soviet Communist system 1917-85 and the politics and revolutionary conflict leading to the dissolution of the Soviet Union from 1985 through 1991. Problems of post-Soviet nation-states of Russia and Central Eurasia since 1991.

Pol S 355. Foreign Policy of Soviet Union and Post-Soviet Central Eurasia. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 251 or comparable background in Soviet/Russian history. History and determinants of Soviet foreign policy from 1941 through 1991, emphasizing Soviet relations with Europe, the United States, China, and the Third World. Foreign relations of the post-Soviet states of Russia and Central Eurasia since 1991.

Pol S 357. International Security Policy. (3-0) Cr. 3. Alt. F., offered 2000. The major theoretical approaches in security policy—strategy and deterrence, game theory, bargaining theory, compellence, and coercive diplomacy, and crisis diplomacy. Illustration of these various approaches through historical and contemporary cases: the outbreak of World War I, the Cuban missile crisis, and U.S.-Soviet arms control negotiations.

Pol S 358. United States Foreign Policy. (3-0) Cr. 3. F. *Prereq:* 215 or 251, or Hist 467 or 470 or 471. U.S. foreign policy since World War II with emphasis on changing American values in foreign policy, the role of the President, Congress, and the bureaucracy in policy making, and a survey of current foreign policy issues and problems.

Pol S 359. Current Issues in American Foreign Policy. (3-0) Cr. 3. S. *Prereq:* 215, 251, or 358. Examination of three or four contemporary U.S. foreign policy issues (e.g., U.S. policy in the Middle East; defense budgeting in the post-Cold War era; conventional and nuclear arms control policy). The course will explore alternate methods to analyze policy, survey the evolution of each issue, and evaluate different policy alternatives.

Pol S 360. Congress and the State Legislatures. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 215. Theory of representation in democratic government. Organization, procedures, voting patterns, and leadership roles of United States Congress and state legislatures.

Pol S 361. The President and the State Governors. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 215. Creation and historical development of the office of chief executive; character and behavior of past chief executives; selection and control; powers, roles, functions; executive staff; relations with Congress, press, public opinion.

Pol S 370. Religion and Politics. (Same as Relig 370.) See *Religious Studies*. Nonmajor graduate credit.

Pol S 371. Introduction to Public Administration. (3-0) Cr. 3. F. *Prereq:* 215. The development of public administration in federal, state, and local government. Analysis of the organization and operations of public agencies in terms of efficiency and effectiveness in developing and implementing public policy.

Pol S 381. Introduction to Political Economy. (3-0) Cr. 3. S. Introduction to the dominant theoretical perspectives on international political economy including Marxism, classical liberalism, and mercantilism. Exploration of specific issues such as the changing international trade regime, the international monetary system, and Third World development. Theoretical concerns will be integrated with the pragmatic economic policy concerns of public officials across the globe.

Pol S 385. Women in Politics. (Same as W S 385.) (3-0) Cr. 3. S. Development of feminism in western democracies; interest groups and leadership in the struggle for political power; countervailing socioeconomic forces that have inhibited women's participation in politics and government; contemporary issues and strategies for change through the political process; emphasis on the United States.

Pol S 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of department cooperative education coordinator; junior classification. Required of all

cooperative education students. Students must register for this course prior to commencing work period.

Pol S 405. Political Socialization and Political Attitudes. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 6 credits in political science or junior classification. The acquisition of political attitudes by pre-adults and adults. Implications for national identity, political culture, and public opinion. Nonmajor graduate credit.

Pol S 406. Public Opinion, Voting Behavior, and Elections. (3-0) Cr. 3. S. *Prereq:* 6 credits in political science or junior classification. Consequences of public opinion and social background for voting behavior, campaigns, and elections. Nonmajor graduate credit.

Pol S 410. Iowa Government and Politics. (3-0) Cr. 3. S. *Prereq:* 215. Analysis of Iowa government and politics: public opinion and political participation, governmental institutions, and major policy issues. Nonmajor graduate credit.

Pol S 413. Federalism and Intergovernmental Relations. (Dual-listed with 513.) (3-0) Cr. 3. S. *Prereq:* 6 credits in American government. Theory and practice of the American federal system; patterns of conflict and sharing in the 19th century; development and expansion of the federal grant-in-aid system; politics and policy making among federal, state, and local governments; techniques of intergovernmental relations. Nonmajor graduate credit.

Pol S 417. Campaign Rhetoric. (Same as Sp Cm 417.) See *Speech Communication*. Nonmajor graduate credit.

Pol S 420. Constitutional Law. (3-0) Cr. 3. F. *Prereq:* 215; junior classification. Development of the United States Constitution through judicial action; influence of public law and judicial interpretations upon American government and society. Nonmajor graduate credit.

Pol S 421. Constitutional Freedoms. (3-0) Cr. 3. S. *Prereq:* 320 or 420. Leading Supreme Court cases interpreting the Bill of Rights and the Fourteenth Amendment. Emphasis on religion, speech, privacy, due process, and equal protection. Nonmajor graduate credit.

Pol S 422. International Law. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 215 or 251; junior classification. Development of the principles of international law of peace and war; analysis of theories concerning its nature and fundamental conceptions; its relation to national law; problems of international legislation and codification. Nonmajor graduate credit.

Pol S 430. Development of Political Thought: Classical Thought through Early Contract Theory. (Same as Cl St 430.) (3-0) Cr. 3. F. *Prereq:* 6 credits in political science, philosophy, or European history. Major concepts in original texts of classical, medieval, and early modern authors: friendship, community, man's basic nature; natural law; force; society outside the political order. Emergence of the modern state and sovereignty in the transition to secular authority. Relevant historical considerations; contemporary applications. Plato through Hobbes. Nonmajor graduate credit.

Pol S 431. Development of Political Thought: Modern and Contemporary Political Thought. (Dual-listed with 531.) (3-0) Cr. 3. S. *Prereq:* 6 credits in political science, philosophy, or European history. Original texts and relevant historical considerations. Human nature and its influence on contract theory; private rights; differing connotations of liberty; sovereignty; constitutionalism; dialectical materialism; bureaucracy; law; democratic theory. Locke through Marx, Mill, and contemporary authors. Nonmajor graduate credit.

Pol S 433. American Political Thought. (3-0) Cr. 3. S. *Prereq:* 6 credits in political science or in American history. Review of major political concepts and theorists in American political history. Analysis of current concepts in U.S. political thought, and their possible impacts on our political institutions. Nonmajor graduate credit.

Pol S 440. Comparative Politics of the Middle East. (3-0) Cr. 3. Alt. yr. *Prereq:* 241 and coursework on the Middle East. Applies comparative methodology to the analysis of problems and issues affecting the Middle

East as a region. Focus on democratization and economic liberalization. Nonmajor graduate credit.

Pol S 443. The U.S. and Latin America. (3-0) Cr. 3. Alt. yr. *Prereq:* 241 or 251 or 343. Analysis of the political consequences of Latin American dependency and growth of nationalism. Monroe Doctrine, aid, revolution, nationalization, multinational corporations. Nonmajor graduate credit.

Pol S 451. International Politics of Asia. (3-0) Cr. 3. F. *Prereq:* 241 or 251. International politics of Asia; emphasis on shifting power balance, role of major powers, security dilemma, foreign policies of small nations, prospect for regional integration. Nonmajor graduate credit.

Pol S 452. Comparative Foreign Policy. (Dual-listed with 552.) (3-0) Cr. 3. S. *Prereq:* 251. Various theoretical approaches to explain foreign policy making and behavior through the use of case studies of selected nations. Nonmajor graduate credit.

Pol S 453. International Organizations. (3-0) Cr. 3. S. *Prereq:* 251. Private and public organizations such as the United Nations, other specialized agencies, and multinational organizations, and their influence on our daily lives. Nonmajor graduate credit.

Pol S 464. Political Parties. (3-0) Cr. 3. F. *Prereq:* 215; junior classification. American political parties, their platforms, organizations, and activities.

Pol S 470. Public Choice. (Same as Econ 470.) See *Economics*. Nonmajor graduate credit.

Pol S 471. Administrative Politics. (3-0) Cr. 3. Alt. yr. *Prereq:* 215. The regulatory process; structure and politics of regulatory agencies; political interactions of agencies, legislators, interest groups, and the legal system. Nonmajor graduate credit.

Pol S 475. Management in the Public Sector. (Dual-listed with 575.) (3-0) Cr. 3. F. *Prereq:* 371. Literature and research on organizational behavior and management theory with emphasis on applied aspects of managing contemporary public sector organizations. Topics include distinctions between public and private organizations, leadership, productivity, employee motivation, organizational structure, and organizational change. Nonmajor graduate credit.

Pol S 476. Administrative Law. (Dual-listed with 576.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 215; junior classification. Constitutional problems of delegation of governmental powers, elements of fair administrative procedures, judicial control over administrative determinations. Nonmajor graduate credit.

Pol S 477. Government, Business, and Society. (Dual-listed with 577.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* Junior classification. Intellectual underpinnings of both private and public sector ethos are explored as well as specific issue arenas such as: pollution, consumerism, social responsibility of business, antidiscrimination in the workplace, government regulation and lobbying. Nonmajor graduate credit.

Pol S 478. Politics of the Bureaucracy. (Dual-listed with 578.) (3-0) Cr. 3. Alt. yr. *Prereq:* Senior classification and 371, or 6 credits of political science. Examination of the interaction between government and politics. Emphasis placed on public administration theorists, and on current behavior among the bureaucracy, Congress, and the executive branches of government. Nonmajor graduate credit.

Pol S 480. Ethics and Public Policy. (Dual-listed with 580.) (3-0) Cr. 3. Alt. yr. *Prereq:* 6 credits in political science. Major ethical concepts in U.S. political philosophy. The controversy over public versus private morality in political policy making. Analysis of public decision-making case studies, with emphasis on ethical considerations. Major proposals and legislation related to improving the quality of ethical criteria and decisions in public policy making. Nonmajor graduate credit.

Pol S 482. Environmental Politics and Policies. (Dual-listed with 582; same as Env S 482.) (3-0) Cr. 3. F. *Prereq:* 3 credits in political science or 3 credits in Environmental Studies; junior classification. Major ideologies relating to conservation and ecology. Primary emphasis on the policy making process in U.S. national and state governments, with principal application to environmental and land-use policies.

Major proposals for improvement in policy content and process. Nonmajor graduate credit.

Pol S 484. Rural and Small Community Development Policy. (Dual-listed with 584.) (3-0) Cr. 3. Alt. yr. *Prereq:* 215. Major policies, local governments, intergovernmental relations, and significant groups and coalitions active in rural and small community environments in developed countries. Education, poverty, housing, recreation, health, conservation and environment, research and extension, manpower, and agriculture. Nonmajor graduate credit.

Pol S 486. Science, Technology and Public Policy. (Dual-listed with 586.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 6 credits in *Political Science: junior or senior classification*. Examines the development of science and technology policy in the United States, including the historical evolution of the government's role in science and technology, the dynamics of government-university-industry relations on technological advancement, and the impact of science and technology on global politics. Nonmajor graduate credit.

Pol S 490. Independent Study. Cr. var. F.S. *Prereq:* 6 credits in *political science*. No more than 9 credits of Pol S 490 may be counted toward graduation. Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory. Use of credit in Pol S major and minor is limited; see department for information.

- A. American Government and Politics
- B. Theory and Method
- C. Comparative Politics
- D. International Relations
- E. Extended credit. The student may earn an additional 1 or 2 credits for extra study done for any 300- or 400-level course, with instructor's approval.
- G. Catt Center Project
- H. Honors

Pol S 495. Capstone Seminar in Political Science. (3-0) Cr. 3. S. *Prereq:* 21 credits in *political science and permission of instructor*. Capstone seminar for political science majors in which classic writings in the discipline would be read and analyzed critically. Original student analysis and research emphasized.

Pol S 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of department cooperative education coordinator; senior classification*. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Pol S 499. Internship in Political Science. Cr. var. F.S.SS. *Prereq:* 6 credits in *political science; junior or senior classification; and permission of internship coordinator*. Work experience with a specific non-governmental or governmental agency at the local, state, national, or international level, combined with academic work under faculty supervision. Offered on a satisfactory-fail grading basis only. Use of credit in Pol S major and minor is limited; see department for information.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Pol S 502. Political Analysis. (3-0) Cr. 3. S. *Prereq:* 6 credits in *political science*. Introduction to systematic reasoning and analysis in political science. Concepts, hypotheses, and major theories introduced. Alternative methods of analysis surveyed.

Pol S 503. Political Research. (3-0) Cr. 3. S. *Prereq:* 6 credits in *political science*. Principles of scientific, empirical research applied to political data and public policies. Research design, ethics, role of theory, types and sources of data. Survey research, voting analysis, program evaluation, computer utilization, interviewing, review of algebra and the role of statistical techniques in research.

Pol S 510. State Government and Politics. (3-0) Cr. 3. Alt. yr. *Prereq:* 310. Comparative analysis of state political systems. Role of interest groups, political parties, legislatures, courts, and governors in state

politics. Possible determinants of public policy outputs at the state level.

Pol S 512. Urban Politics and Administration. (3-0) Cr. 3. Alt. yr. *Prereq:* 311. Structure and process of urban politics and the metropolitan political systems; problems in urban management and intergovernmental relations; theoretical perspectives on urban politics and policy.

Pol S 513. Federalism and Intergovernmental Relations. (Dual-listed with 413.) (3-0) Cr. 3. S. *Prereq:* 6 credits of *American government*. Theory and practice of the American federal system; patterns of conflict and sharing in the 19th century; development and expansion of the federal grant-in-aid system; politics and policy making among federal, state, and local governments; techniques of intergovernmental relations.

Pol S 531. Development of Political Thought: Modern and Contemporary Political Thought. (Dual-listed with 431.) (3-0) Cr. 3. Alt. yr. *Prereq:* 430. Original texts and relevant historical considerations. Human nature and its influence on contract theory; private rights; differing connotations of liberty; sovereignty; constitutionalism; dialectical materialism; bureaucracy; law; democratic theory; Locke through Marx, Mill, and contemporary authors.

Pol S 535. Contemporary Political Philosophy. (Same as Phil 535.) See *Philosophy*.

Pol S 544. Comparative Public Policy. (3-0) Cr. 3. Alt. yr. *Prereq:* 6 credits in *political science*. Examines how, why, and to what effect governments deal with substantive policy problems differently. Environmental factors, ideologies, cultures, domestic policy making processes, and interest groups.

Pol S 547. Political Leadership and Elites. (3-0) Cr. 3. Alt. yr. *Prereq:* 6 credits in *political science*. Various forms of leadership and leader-follower relations. Obligations, exchanges, incentives, coercion, corruption, bossism in both the U.S. and foreign experience.

Pol S 549. Comparative Political Behavior. (3-0) Cr. 3. Alt. yr. *Prereq:* 305 or 405. Empirical analysis of political behavior in cross-national perspective, including activist participation, level of political sophistication, cleavage structures and voting, role of partisan identification.

Pol S 552. Comparative Foreign Policy. (Dual-listed with 452.) (3-0) Cr. 3. S. *Prereq:* 251. Various theoretical approaches to explain foreign policy making and behavior through the use of case studies of selected nations.

Pol S 559. International Relations Theory. (3-0) Cr. 3. F. *Prereq:* 6 credits in *international studies*. Selected theoretical writings, both classical and contemporary, on world politics. Realism, war and conflict, peace and cooperation, political economy, crisis decision making, and transnational relations.

Pol S 560. Legislative Behavior. (3-0) Cr. 3. Alt. yr. *Prereq:* 360 or equivalent. Principles, procedures, and problems of the legislative process. Policy-making in state legislatures and the U.S. Congress.

Pol S 561. The Chief Executive. (3-0) Cr. 3. Alt. yr. *Prereq:* 6 credits in *American government*. Legal and political forces influencing the U.S. president, governors, and other governmental executives in decision making, developing and administering programs of government, leading public opinion, and influencing legislation.

Pol S 571. Organizational Theory in the Public Sector. (3-0) Cr. 3. F. *Prereq:* 6 credits in *political science*. Major theories of administrative organization, including motivations of administrators and organizations, comparisons of organizational arrangements, factors affecting organizational arrangements, and formal and informal decision-making structures.

Pol S 572. Public Budgeting and Financial Management. (3-0) Cr. 3. F. *Prereq:* 6 credits in *political science*. The process of public budgeting. Alternative budget systems including taxation, the appropriation process, program evaluation, and debt and risk management at federal, state, and local levels.

Pol S 573. Public Personnel Administration. (3-0) Cr. 3. S. *Prereq:* 6 credits in *political science*. Recruitment, retention, and development of employees; merit systems, collective bargaining, and grievance procedures.

Pol S 574. Methods of Policy and Program Evaluation. (3-0) Cr. 3. S. *Prereq:* 9 credits in *political science*. Integration, application, and utilization of public administration and public policy concepts in the interpretation of results and effectiveness of public programs and the prediction of consequences for policymakers and administrators.

Pol S 575. Management in the Public Sector. (Dual-listed with 475.) (3-0) Cr. 3. F. *Prereq:* 6 credits in *political science*. Literature and research on organizational behavior and management. Theory with emphasis on applied aspects of managing contemporary public sector organizations. Topics include distinctions between public and private organizations, leadership, productivity, employee motivation, organizational structure, and organizational change.

Pol S 576. Administrative Law. (Dual-listed with 476.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* *Graduate classification*. Constitutional problems of delegation of governmental powers, elements of fair administrative procedures, judicial control over administrative determinations.

Pol S 577. Government, Business, and Society. (Dual-listed with 477.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* *Graduate classification*. Intellectual underpinnings of both private and public sector ethos are explored as well as specific issue arenas such as: pollution, consumerism, social responsibility of business, antidiscrimination in the workplace, government regulation and lobbying.

Pol S 578. Politics of the Bureaucracy. (Dual-listed with 478.) (3-0) Cr. 3. Alt. yr. *Prereq:* *Graduate classification and 371, or 6 credits of political science*. Examination of the interaction between government and politics. Emphasis placed on public administration theorists, and on current behavior among the bureaucracy, Congress, and the executive branches of government.

Pol S 580. Ethics and Public Policy. (Dual-listed with 480.) (3-0) Cr. 3. Alt. yr. *Prereq:* 6 credits in *political science*. Major ethical concepts in U.S. political philosophy. The controversy over public versus private morality in political policy making. Analysis of public decision-making case studies, emphasis on ethical considerations. Major proposals and legislation related to improving the quality of ethical criteria and decisions in public policy making.

Pol S 581. International Political Economy. (3-0) Cr. 3. S. *Prereq:* 6 credits in *political science*. An overview of the international political economy since the end of World War II. Special emphasis on national (primarily U.S.) development assistance and agricultural/food politics and policies, and those of the international food organizations, the World Bank, and the regional development banks.

Pol S 582. Environmental Politics and Policies. (Dual-listed with 482.) (3-0) Cr. 3. F. *Prereq:* 3 credits in *political science or 3 credits in Environmental Studies; graduate classification*. Major ideologies relating to conservation and ecology. Primary emphasis on the policy making process in U.S. national and state governments, with principal application to environmental and land-use policies. Major proposals for improvement in policy content and process. Nonmajor graduate credit.

Pol S 584. Rural and Small Community Development Policy. (Dual-listed with 484.) (3-0) Cr. 3. Alt. yr. *Prereq:* *Graduate classification*. Major policies, local governments, intergovernmental relations, and significant groups and coalitions active in rural and small community environments in developed countries. Education, poverty, housing, recreation, health, conservation and environment, research and extension, manpower and agriculture.

Pol S 586. Science, Technology and Public Policy. (Dual-listed with 486.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 6 credits in *Political Science*. Investigates the dynamics of interaction between science and politics at the national and international

level and how this interaction shapes policy for science, human welfare, and global concerns. The topics include the evolutionary relationship between science and government; the old and new social contract for science; national innovation policy; and global economic and environmental concerns.

Pol S 590. Special Topics. Cr. 2 to 5 each time taken. F.S. *Prereq:* 15 credits in political science, written permission of instructor.

- A. American Political Institutions
- B. Public Law
- C. Political Theory and Methodology
- D. Comparative Government
- E. International Relations
- F. Political Parties and Policy Formation
- G. Public Administration and Public Policy
- I. Internship
- T. Teaching Preparation

Pol S 599. Creative Component.

Courses for Graduate Students

Pol S 610. Graduate Seminars. (3-0) Cr. 3 for each seminar. F.S. *Prereq:* 15 credits in political science.

- A. American Political Institutions
- B. Public Law
- C. Political Theory and Methodology
- D. Comparative Government
- E. International Relations
- F. Policy Process
- G. Public Administration and Public Policy

Pol S 699. Research.

Preprofessional Study

Requirements for admission to most professional academic programs can be met by study at Iowa State University. These requirements may be met in the course of obtaining a bachelor's degree from Iowa State or at a level below that of a degree, depending on the intended field of study. The specific courses taken in a preprofessional program will depend primarily upon the admission requirements of the professional schools to which a student wants to apply. In some programs requiring three years of preprofessional work, a student may, by careful planning, complete requirements for the bachelor's degree upon transferring to Iowa State up to 32 semester credits of professional coursework. Generally these credits will be counted as electives, but a maximum of 24 may be used as major credits in interdisciplinary studies and a smaller number as major credits in appropriate departments.

Students who have not declared a major upon entry should enter as preprofessional students, i.e., premedical, prelaw, PHP (preprofessional health programs), or GENPV (General Undergraduate Studies Pre Vet), until they choose a major or transfer to a professional school. All students, whether they have selected a major or not, are encouraged to identify their interest in a professional career by designating it on their application or by completing a preprofessional interest form during registration.

Information about preprofessional program admissions requirements and career opportunities in human health or law may be obtained in the Liberal Arts and Sciences Advising Center. Information about veterinary medicine admissions requirements and career opportunities may be obtained from the coordinator of

the preveterinary program in the Office of the Dean of the College of Veterinary Medicine.

Clinical Laboratory Science/Medical Technology

Clinical laboratory scientists, still commonly referred to as medical technologists, are important members of health-care teams. They perform the chemical, microscopic, radio-assay, and microbiological tests that are necessary in disease diagnosis, and they type and cross-match blood samples to facilitate blood transfusions. They usually work under the supervision of a physician in a hospital or clinic laboratory, but may also be employed by a pharmaceutical company or by manufacturers of analytical instruments. The professional training requires 12 months in a hospital-based CLS/MT program following at least 3 years of college study that emphasizes chemistry and the biological sciences. Students may earn a bachelor's degree by completing the admissions requirements of the CLS/MT program and most of the degree requirements in 3 years on campus, then spending their fourth year in one of the hospital programs that are affiliated with Iowa State University. Before beginning the off-campus studies, students must earn at least 94.5 credits; the 32 most recent credits must have been earned in residence at ISU. A maximum of 32 semester credits earned in professional CLS/MT school can be used to partially fulfill the requirements for the bachelor's degree. Students who complete all degree requirements in residence at the university may apply to any school of medical technology for which the admission requirements have been met.

The following CLS/MT programs are affiliated with Iowa State University:

Mercy Hospital Medical Center, Des Moines, Iowa. Program Director: Stacy Sime. Medical Director: Vijaya L. Dhannavada

St. Luke's Methodist Hospital, Cedar Rapids, Iowa. Education Coordinator: Nadine Sojka. Medical Director: Dorryl Buck.

University of Iowa Hospitals, Iowa City, Iowa. Program Director: Marian Schwabbauer. Medical Director: Robert D. Tucker.

The following courses, with variable credit, are offered in the above programs (contact the Liberal Arts and Sciences Advising Center for course descriptions):

- 401C. Medical Technology Practicum.
- 402C. Clinical Immunology.
- 403C. Clinical Chemistry.
- 404C. Clinical Immunohematology.
- 405C. Clinical Hematology.
- 406C. Clinical Microbiology.
- 407C. Urinalysis, Body Fluids, Microscopy.
- 408C. Senior Seminar.
- 412C. Clinical Immunology Laboratory.
- 413C. Clinical Chemistry Laboratory.
- 414C. Clinical Immunohematology Laboratory.
- 415C. Clinical Hematology Laboratory.
- 416C. Clinical Microbiology Laboratory.
- 417C. Urinalysis, Body Fluids, Microscopy Laboratory.

Cytotechnology

A cytotechnologist works in a medical laboratory preparing, staining, mounting, and evaluating specimens of human body tissues in order to find those cells that are abnormal. The abnormal specimens are then submitted to the pathologist supervising the laboratory for confirmation and interpretation. The training requires 12 months in a school of cytotechnology after at least 3 years of college study that includes a minimum of 20 semester credits in biological sciences, 8 semester credits in chemistry, and 3 semester credits in math. Certification as a cytotechnologist requires a baccalaureate degree. Students may enter the professional school after earning a bachelor's degree in a related field. Alternatively, they may use up to 32 semester credits from an affiliated cytotechnology school in partial fulfillment of requirements for a B.S. degree.

An Interdisciplinary Studies major must earn 94.5 credits before off-campus study; the most recent 32 credits must have been earned in residence at ISU.

Currently the only school of cytotechnology in Iowa is a postbaccalaureate certificate program at Mercy Hospital Medical Center in Des Moines. Iowa State University is affiliated with the School of Cytotechnology of the State Laboratory of Hygiene at the University of Wisconsin-Madison. The following combination lecture and laboratory courses are offered in the UW-Madison 12-month professional program (contact the Liberal Arts and Sciences Advising Center for course descriptions):

- 410C. Basic Cytology and Laboratory Procedures.
- 420C. Advanced Laboratory Procedures.
- 440C. Seminar in Clinical Cytogenetics.
- 441C. Seminar in Laboratory Operations and Quality Control.
- 442C. Seminar in Clinical Cytology.
- 452C. The Female Reproductive System.
- 455C. The Respiratory System.
- 456C. The Urinary and Male Reproductive Systems.
- 457C. The Gastrointestinal System.
- 458C. Effusions.
- 459C. The Central Nervous System.
- 460C. The Breast.
- 461C. Miscellaneous Systems.
- 480C. Clinical Practice I.
- 481C. Applied Cytology I.
- 482C. Advanced Clinical Practice.
- 483C. Applied Cytology II.

Dental Hygiene

A dental hygienist screens dental patients for oral defects, performs clinical procedures such as cleaning teeth, and may participate in oral health education programs. Most work with dentists in private practice, but some have positions in public health centers and schools. Certification as a dental hygienist requires 2 years in a professional program of study. Admissions requirements for these programs vary. A student may study for 2 years at Iowa State University and then transfer to an institution that grants the bachelor's degree in dental hygiene. Alternatively, a student may earn a

bachelor's degree in another field at Iowa State before entering a professional program.

Dentistry

Dentists diagnose, treat, and try to prevent diseases and injuries of the teeth, jaws, and mouth. Usually a general practitioner will have spent 3 or 4 years taking preprofessional courses at the undergraduate level and 4 years in dental school earning the degree of doctor of dental surgery (D.D.S.) or doctor of dental medicine (D.M.D.). Learning a specialty requires at least 2 more years. The courses necessary for admission to most dental schools include English, biology, general and organic chemistry, and physics. Students may earn a degree in any major that Iowa State University offers as they meet the admission requirements; they should choose their major to reflect their own interests and abilities. Highly qualified students may be accepted into dental school after 3 years of preprofessional study without earning a baccalaureate degree.

Health Information Management

Health information managers serve as supervisors of medical records departments in hospitals, clinics, nursing homes, and other health-care institutions. To be certified as registered record administrators (R.R.A.) they must have completed a program leading to a bachelor's degree in medical record administration. Most professional programs are 2 years in length and follow 2 years of college study in chemistry, biology, the humanities, social sciences, languages, and philosophy. Students may take the preprofessional courses at Iowa State University and then transfer to a university offering the professional program or they may earn a bachelor's degree at Iowa State University before entering a health information management program.

Hospital and Health Administration

Administrators of health care organizations manage and guide the varied activities in hospitals, clinics, nursing homes, and mental health facilities. The professional requirement may be for a master's degree or a bachelor's degree, depending upon the size of the institution and whether an upper or middle entry-level position is desired. Students at Iowa State may take general education courses for two or more years and then transfer to a university offering a bachelor's degree in health administration, or they may spend four years earning a bachelor's degree in any department before entering a master's degree program at the University of Iowa or other university. Courses required for admission to master's degree programs in hospital and health administration vary, but may include introductory accounting, management, statistics, and economics.

Human Medicine

Physicians study, diagnose, and treat illness and injury. They may work in offices, clinics, hospitals, or laboratories, in private practice or for government or industry. Their professional training usually consists of 4 years of study in a college of medicine to earn the doctor of medicine (M.D.) degree, and then 3 or more years in hospital residency learning a specialty such as family medicine, pediatrics, surgery, obstetrics, or psychiatry. A degree of doctor of

osteopathy (D.O.) is awarded to those students who complete 4 years in a college of osteopathic medicine before their residency. All medical schools recommend a broad pre-professional education that includes courses in biology, chemistry, physics, mathematics, English, the social sciences, arts and humanities. Although many medical schools admit a small number of exceptionally well-qualified applicants after 3 years of preprofessional study, most students earn a bachelor's degree while taking the courses required for admission to medical school. This degree can be from any college and in any curriculum or major offered by the university. The major should reflect the student's interests and provide appropriate preparation for an alternative career.

Law

A lawyer assists the legal, peaceful resolution of conflicts in many different ways. Most lawyers are engaged in private practice, but many are employed by government agencies and private business. At least 3 years are needed to complete a law school program leading to a doctor of jurisprudence (J.D.) or a bachelor of laws (LL.B.) degree, and a bachelor's degree is required for admission to nearly all law schools. A student planning to enter law school may major in any field. The courses taken should develop skill in critical thinking, comprehension and expression of ideas, and understanding of human institutions and values. Perhaps most valuable are courses in English language and literature, government, economics, history, mathematics, Latin, logic and scientific method, and philosophy.

Library and Information Science

Librarians are essential in educational institutions, medical facilities, government agencies, industries, and public information centers. The professional preparation for library administration is provided by master's degree programs. Admission requirements for the University of Iowa's program, for example, include a bachelor's degree with at least 85 semester credits in the arts and humanities and the natural and social sciences. Iowa State students may choose majors that reflect their own interests and that may provide a foundation for working in medical, law, or other specialized libraries.

Nuclear Medicine Technology

The use of radioactive chemicals in the diagnosis and treatment of disease is the distinguishing feature of nuclear medicine. Under the supervision of a physician in a hospital or clinic, the technologist prepares and administers these radiochemical tracers, uses sophisticated detectors and computers to trace the movement and localization of the tracers in the human body, and analyzes biological specimens to determine levels of hormones, drugs, and other chemicals in the body. One year in a training program such as that at the University of Iowa College of Medicine is required to become a certified nuclear medicine technologist (C.N.M.T.). Admission to this program requires at least 94 semester credits of preprofessional coursework in chemistry, physics, zoology, English, mathematics, computer science, statistics, the social sciences, and humanities. Students at Iowa State University can transfer to a university offering a nuclear

medicine technology program after 2 or 3 years of preprofessional courses, and then receive the bachelor's degree at that institution. Alternatively, the student may earn a bachelor's degree before entering the 1-year professional program or may spend 3 years at Iowa State University meeting the admissions requirements of the program and completing requirements for a B.S. degree using a maximum of 32 semester credits that may be transferred to Iowa State University from the professional school.

Nursing

A professional nurse may do clinical nursing, teaching, or research, in hospitals, private practice, public health centers, schools, or industry. Although becoming a registered nurse (R.N.) does not require a bachelor's degree, the student who completes the bachelor of science degree in nursing (B.S.N.) has college-level preparation for clinical nursing and an essential base for graduate study. Iowa State University does not offer a nursing degree but does participate in a transfer program with the University of Iowa and Grand View College in Des Moines. Students take specified courses for 2 years at Iowa State University and, if accepted in the University of Iowa College of Nursing, complete the B.S.N. requirements and the R.N. examination in another 21/2 years. If accepted at Grand View College, they may complete the B.S.N. requirements and take the R.N. examinations in 2 years. Students may also elect to transfer to a B.S.N. program at another college or university. Most of these programs require a minimum of 3 years of resident study, but their requirements vary, so early planning for transfer is essential.

Occupational Therapy

Occupational therapists provide purposeful activities to help those who have been disabled by physical illness or injury, birth defects, emotional disorder, aging, drug abuse, or other problems to learn to cope with everyday living. Therapists treat patients in hospitals, school systems, and rehabilitation centers. Students may elect one of two paths to certification as registered occupational therapists (O.T.R.). They may complete a bachelor's degree in a related area at Iowa State University, and then enter a certification or master's degree program at another university; or they may complete 1 or 2 years of preoccupational therapy courses at Iowa State and then transfer to another university to complete the requirements for a bachelor's degree in occupational therapy. The prerequisites for admission to an occupational therapy program usually include English, art, biology, chemistry, physics, psychology, sociology, anthropology, and statistics, but vary from one school to another.

Optometry

Optometrists examine, diagnose, treat and manage diseases of the visual system, the eye and associated structures. Treatment may include corrective glasses or contacts, vision therapy and therapeutic drugs. Optometrists usually set up their own offices or work in group practice. Professional study requires 4 years in a school or college of optometry and leads to the doctor of optometry (O.D.) degree. All optometry schools require at least 90 semester credits of preprofessional courses

es, including biology, chemistry, physics, mathematics, and English. Certain optometry schools require a bachelor's degree. Students wishing to earn the bachelor's degree from Iowa State University may choose any major and take the courses required for graduation with that major as they take the courses required for admission to a professional optometry program. Alternatively, students may take only courses required for admission to the professional school without earning a bachelor's degree.

Physical Therapy

Physical therapists work with people who have been disabled by injury, illness, or birth defects. They assist in evaluating the physical problems and administer therapeutic agents such as massage and exercise, heat, baths, ultrasonics, and electricity; they work in hospitals, clinics, nursing homes, schools, rehabilitation centers, and private practice. Students have several options in planning their education. They may transfer after two years at Iowa State University to a college or university offering physical therapy as a bachelor's degree program. They may complete three years of undergraduate courses including prerequisites before transferring to a three-year professional curriculum such as the master's degree program at St. Ambrose University or the doctoral degree program at Creighton University. Usually, students earn a bachelor's degree in a related field at ISU before spending two years in a professional school to earn a master's degree or certificate. Admission to the master's degree program at the University of Iowa requires a bachelor's degree. The bachelor's degree from ISU may be earned in any department, provided that the physical therapy prerequisites are completed. Earning a bachelor's degree prior to entering professional school allows a student to apply to a range of graduate level programs and builds a strong liberal arts foundation. Courses required for admission to a professional program include biology, chemistry, physics, psychology, mathematics, and statistics.

Physician Assistant

A physician assistant provides medical services under the supervision of a licensed physician, frequently in a rural or inner-city clinic. The responsibilities may include taking patients' histories, physical examinations, prescription of laboratory studies, diagnosis and treatment of common problems, follow-up care, and counseling. Certification as a physician assistant requires 2 years in a professional program at the master's or bachelor's degree level. Students applying to a bachelor's degree program must have completed at least 60 semester credits of college work including general and organic chemistry, zoology, behavioral science, and humanities. Mathematics and physics courses are recommended, and applicants who have had health-care experience with direct patient contact are preferred. Admission to a master's degree program requires similar coursework and experience in addition to a bachelor's degree.

Podiatry

Podiatrists diagnose, treat, and try to prevent diseases and disorders of the human foot and ankle. They treat patients in private and group

practice, hospitals, and, increasingly, in industrial and sports-related positions. Professional training requires 4 years in a college of podiatric medicine and leads to the degree of doctor of podiatric medicine (D.P.M.). This is usually followed by 1 to 3 years in a hospital residency. All podiatric colleges require at least 3 years of preprofessional study, including courses in biology, general and organic chemistry, physics, and English. Most entrants have a bachelor's degree, which may be in any major. A few students may complete the admission requirements and most of the bachelor's degree requirements in 3 years. If so, a maximum of 32 semester credits may be transferred to Iowa State University from the first year in an accredited podiatric college in order to complete the requirements for the bachelor's degree.

Speech-Language Pathology and Audiology

Specialists in communication disorders help with the diagnosis and correction of speech, language, and hearing problems, working usually in clinics, hospitals, or schools. A certificate of clinical competence in speech-language pathology or audiology requires a master's degree, for which a student must study at another university. Preparation for graduate work should include study of the normal processes of speech, learning, and language in courses such as Introduction to Communication Disorders, Phonetics, Speech and Hearing Mechanism, Psychology of Language, Language Development, Speech and Hearing Science, Statistics, Introduction to Psychology, The Physics of Sound, and at least one biology or zoology course. Supervised clinical observation is advantageous. Further coursework may emphasize psychology or child development, but requirements for admission to the professional programs will vary from one to another. A bachelor's degree, in any major is required for admission to the master's degree programs. More information is available in the Department of Psychology (Communication Disorders Option).

Theology or Religious Studies

The professional education of a student of religion can follow one of two paths. The path to a profession as a pastor, priest, rabbi or other leadership position in a religious tradition usually requires 3 years in a program leading to the master of divinity (M.Div.) offered at a school of divinity or of theology. The path to a profession as a teacher of religious studies at the college level requires 4-10 years in a program leading to the Ph.D. at a graduate school of Religious Studies. Both seminaries and graduate schools require a bachelor's degree for admission. The American Association of Theological Schools recommends the following areas of study as the best preparation for theological studies: English language and literature; history, including non-Western culture; philosophy; natural sciences, social sciences, especially psychology, sociology and anthropology; the fine arts; Biblical and modern languages; and religion, both Western and Eastern. Although students in a variety of major fields may qualify for admission to a theological school, interested persons are advised

to review their proposed programs with a representative of the Religious Studies Program.

Veterinary Medicine

About 75% of all veterinarians are engaged in private practice. In a mixed practice, they diagnose and treat health problems among a variety of animals. Others specialize in one species (e.g., feline, pet bird) and still others specialize in a specific discipline within veterinary medicine (e.g., cardiology, ophthalmology). Veterinarians may also choose public and corporate practice (e.g., public health, education, research, food safety, industry, laboratory animal medicine, aquatic animal medicine, poultry medicine, and military veterinary medicine).

The professional program requires four years at a college of veterinary medicine and leads to the doctor of veterinary medicine degree (D.V.M.). Admission to a veterinary college involves at least two years of preprofessional college education. Candidates must take courses in biology, chemistry, genetics, physics, English, humanities, social sciences and speech. (For Iowa State University see *Veterinary Medicine, Admission Requirements*.)

Students may pursue their preveterinary preparation in any college at Iowa State University. A major (preveterinary medicine is not a major) should be selected that is allied to each student's vocational interests in veterinary medicine or that otherwise offers vocational satisfaction in the event that plans for entry into the College of Veterinary Medicine change. Students are encouraged to pursue a bachelor's degree; the most effective progress toward a bachelor's degree is made when a major is selected upon entry and no change occurs before graduation. However, students who have not even considered a career other than veterinary medicine may need some time to explore possibilities before selection of a major.

To assist students who have indicated interest in the preveterinary program for the College of Veterinary Medicine and are undecided about a major, an advising category is available known as GENPV (General Undergraduate Studies Pre Vet). Orientation and advising services for these students are designed to help students fulfill preveterinary course requirements, to introduce available majors and careers allied to veterinary medicine, and to introduce career options in veterinary medicine. GENPV students must select a major by the end of their second semester. Some Iowa State University majors allow, by careful planning, the opportunity for a student to earn the bachelor's degree by combining credits from three years of pre-professional study and one year of professional study in the College of Veterinary Medicine.

Production/ Operations Management

(Administered by the Department of Logistics, Operations and Management Information Systems)

Michael R. Crum, Chair of Department

Distinguished Professors: Allen, Baumel

Professors: Crum, Poist, Wacker

Professors (Emeritus): Thompson, Voorhees

Associate Professors: Chu, Nilakanta, Norris, Premkumar, Walter

Assistant Professors: Goldsby, Hendrickson, Johnson, Strader, Suzuki, Zhu

Instructors (Adjunct): Blanshan, Choobineh

Undergraduate Study

For undergraduate curriculum in business, major in production and operations management, see *College of Business, Curricula*.

The production/operations management major offers a well-planned integrated delivery system focused on those students seeking careers in the scheduling and management of resources in manufacturing or service industries or government. This major provides business students with a detailed understanding of current issues in manufacturing management, material requirements planning (MRPI), manufacturing resource planning (MRPII) and enterprise requirement planning (ERP) including electronic data interchange, quality management, theory of constraints, and just-in-time manufacturing. The curriculum facilitates students understanding of current manufacturing practices in businesses so they can become gainfully employed in manufacturing industries. The major provides training for understanding successful manufacturing practices and for manufacturing organizations and their professional society, the American Production and Inventory Control Society (APICS).

Students are required to take three courses - POM 420, 422, and 424. In addition, students are required to select three additional courses from an approved list.

Graduate Study

The production/operations management major participates in two graduate programs: the M.S. in Business Administrative Sciences and the full-time and part-time M.B.A. programs. The M.S. program is a 30-credit curriculum culminating in a thesis.

The M.B.A. programs are 48-credit, nonthesis, noncreative component curricula. Twenty-four of the 48 credit hours are core courses and the remaining 24 are graduate electives. Students can obtain a Manufacturing and Quality Specialization in the M.B.A. Program by taking 12 credit hours of graduate courses from a selected set of courses.

Fully-admitted M.B.A. degree candidates with previous business study as an undergraduate

may qualify for advanced entry into the M.B.A. programs. Advanced entry is designed to serve those students with a bachelor's degree in business as they may complete the M.B.A. degree program requirements in as few as 30 semester credit hours. Information about the advanced M.B.A. entry application process can be obtained in the College of Business Graduate Programs Office, 218 Carver Hall.

Courses open for nonmajor graduate credit: POM 420, 422, 424, 428.

Courses Primarily for Undergraduate Students

POM 320. Production/Operations Management. (3-0) Cr. 3. *Prereq: Stat 227.* An integrated analysis of basic production/operations systems. Applied forecasting, aggregate planning, scheduling, shop floor control, total quality management, inventory management, facility layout, and project management.

POM 420. Decision Models for Business. (3-0) Cr. 3. *Prereq: Stat 227.* Topics include: Business applications of decision theory, inventory theory, business forecasting, optimization models, the transportation algorithm with trans-shipment, introduction to decision support systems, and network models. Nonmajor graduate credit.

POM 422. Manufacturing Planning and Control. (3-0) Cr. 3. *Prereq: 320.* In-depth analysis of integrated operations management systems with emphasis on operations planning and control, material requirements planning, master scheduling, forecasting, capacity planning, and related topics. Nonmajor graduate credit.

POM 424. Competitive Manufacturing Management. (3-0) Cr. 3. *Prereq: 320.* Advanced topics in operations management focused on concepts, techniques, and systems used to improve a company's competitive advantage in manufacturing, with an emphasis on lean manufacturing, continuous improvement, time-based competition, bar coding, electronic data interchange (EDI), and theory of constraints. Nonmajor graduate credit.

POM 428. Special Topics in Operations Management. (3-0) Cr. 3 each time elected. *Prereq: 320.* In-depth analysis of current issues, problems, and systems in operations management with emphasis on new theoretical and methodological developments. Topics may include in different semesters, supply chain management, productivity and quality improvement, management of technology and innovation, information technology in operations management, and service operations management. Nonmajor graduate credit.

POM 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq: 320, senior classification, permission of instructor.*

Courses Primarily for Graduate Students. Open to Qualified Undergraduate Students

POM 502. Operations Management and Strategy. (2-0) Cr. 2. *Prereq: Graduate classification, Stat 328.* The basic planning and control procedures for service and manufacturing systems. Forecasting, Pareto analysis, aggregate planning, resource requirements planning, scheduling, quality management. Strategic operations management topics including world class manufacturing process. Manufacturing and service case studies.

POM 521. Strategic Quality Management. (3-0) Cr. 3. *Prereq: Stat 328 or equivalent, graduate classification.* Management and technical issues related to quality problem solving, including the strategic importance and economic impacts of quality, managerial issues in planning and designing quality assurance systems, control of quality systems, employee involvement, statistical concepts relevant to designing for quality, inspection and measurement, process control, and acceptance sampling. Uses projects to experience diagnosing and solving real quality problems.

POM 525. Topics in World Class Manufacturing. (3-0) Cr. 3. *Prereq: 502 or equivalent.* The course analyzes competitive advantage in manufacturing. Analytical topics may include global competitive strategies, manufacturing facility strategies, quality, productivity, delivery performance and manufacturing flexibility, inventory analyses, information technology and measurement issues.

POM 528. Intelligent Systems for Business. (3-0) Cr. 3. *Prereq: Graduate classification or permission of instructor.* Design of intelligent systems such as neural networks, genetic algorithms, and fuzzy logic for manufacturing and business applications. Hands-on practice on bankruptcy prediction, credit approval, data mining for marketing, manufacturing cell formation, automated inspection, and scheduling.

POM 590. Special Topics. Cr. 1 to 3 each time taken. *Prereq: Permission of instructor.* For students wishing to do individual research in a particular area of POM.

Professional Agriculture

(Interdepartmental Program administered by the Department of Agricultural Education and Studies)

Supervisory Committee: Eric Hoiberg, Kenneth Holscher, Steve Jungst, Paul Lasley, Sergio Lence, Dan Loy, Kenneth Moore, Gary Munkvold, James Pease

Undergraduate Study

Through the College of Agriculture, Iowa State University offers the bachelor of science degree in professional agriculture designed specifically for those students who choose to study away from the Ames campus.

Graduates have a broad base of agricultural knowledge, the ability to communicate effectively, and skills in problem solving. They have an understanding of technology and the ability to live and work in a global society. Many students take a portion of their coursework from colleges in close proximity to their homes and transfer the credit to ISU. The agricultural coursework (a minimum of 45 credits) is a well-rounded mix of agricultural topics delivered via video-tapes, world wide web, interactive video, off-campus site classes, and on-campus workshops and laboratories. For curriculum detail see *Professional Agriculture, College of Agriculture, Curricula*.

Visit our website at www.ag.iastate.edu/centers/proag/

Graduate Study

The graduate major in professional agriculture is an off-campus program leading to the degree master of agriculture. The program is considered to be a professional master's degree and not preparation for further graduate study. Graduates have a broad base of knowledge in one or more agriculture disciplines. They have the ability to communicate effectively and make decisions based on knowledge. To earn the 32 credits necessary for graduation, students must complete 24 semester credits of formal coursework, 4 semester credits of workshops, and 4 credits of creative component. Courses are delivered

via video-tapes, interactive video, world-wide web, on and off campus classes and workshops. Specific courses offered in the program and the location of the off-campus classes may be obtained from the departmental course listings, off-campus course catalog, or by contacting the Professional Agriculture Coordinator, 201 Curtiss Hall.

Psychology

Douglas L. Epperson, Interim Chair of Department

Distinguished Professors: Wells

Professors: Andre, Bonett, Borgen, Conger, Cutrona, Edwards, Gerrard, Gibbons, Hughes, Peters, Russell

Distinguished Professors (Emeritus): Ahmann

University Professors (Emeritus): Brown

Professors (Emeritus): Avant, Bath, Charles, Hannum, Karas, Layton, Lewis, Schuster, Strahan, Warman, Wolins, Zytowski

Associate Professors: Bushman, Cunnick, Dark, Epperson, Gunter, Hanisch, Larson, O'Boyle, Phye, Scott, Venkatagiri

Assistant Professors: Cooper, Cross, Hoyt, Vallier

Assistant Professors (Adjunct): Mason

Undergraduate Study

For the undergraduate curriculum in Liberal Arts and Sciences, with a major in psychology, leading to the degrees of bachelor of arts and bachelor of science, see *Liberal Arts and Sciences, Curriculum*.

An undergraduate major in psychology may be taken as liberal education, as preparation for graduate study in psychology, or as background for professional education in law and in the health professions. An undergraduate psychology major with a concurrent major or minor in departments such as business administration, family environment, or sociology may qualify with a bachelor's degree for positions in business personnel and social welfare systems as well as for professional work in correctional, rehabilitation, and developmental disability centers. Such diversified education must be planned early in the undergraduate's career in close consultation with an adviser.

The requirements of the program enable graduates to understand and apply the scientific principles, facts, and basic methods of psychology in their personal and professional activities. Graduates learn to think scientifically about human behaviors and mental processes. They can communicate effectively in speech and in writing, respect individual and cultural differences in behaviors, and appreciate ethical issues in both the science and practice of psychology. Professional work with a job title of psychologist in academic, business, clinical, government, and school settings requires graduate degrees.

Departmental requirements for all majors include the following supporting courses: 6

credits in philosophy including 201; two of the following courses: Biol 109 or 201, Zool 155, Chem 163, Gen 260; one of the following courses: Stat 101, 104, or 227; and a course in mathematics acceptable in group IIIa. In addition to the supporting courses specified above, students electing a B.S. degree must complete a minimum of 10 more supporting credits (3 in group IIIa, 6 in group IIIb, and 1 in a laboratory course in group IIIb). Students electing a B.A. degree must complete a minor.

All majors must complete the following psychology courses: 101, 102, 111, 201, 301, and 440 with a minimum grade of C- and with an average grade of C or better for these courses. All majors must also complete five courses distributed across at least four of the following five areas: Area A - 230; Area B - 280; Area C - 310, 315; Area D - 312, 313, 316; Area E - 360, 460. Two additional 3-credit courses must be taken either from these areas or from any of the other courses offered by the department, excluding 470, 490, 491, and 492. The student must earn a C average or better for these seven courses. Students electing a B.S. degree must also complete 302.

See also the B.S./M.S. program under *Graduate Study*.

The department offers a minor in psychology which may be earned by completing 18 credits in psychology, including 101, 301, and 440. At least 9 of the 18 credits must be in 300 level courses and above and no more than 3 of the 9 credits may be in Psych 490, 491, and 492. A grade of C- or better must be earned for each graded course used to satisfy the requirements for the minor. Contact the psychology advising office for more information.

English proficiency requirement: The department requires a grade of C- or better in each of English 104 and 105 (or 105H), and in one of the following courses: Psych 302, Psych 490 (2 credits minimum), or Engl 302, 309, or 314.

Communication Disorders (CmDis)

The curriculum is preprofessional and consists of coursework in speech-language pathology and audiology, as well as study in related disciplines. It provides a broad-based background in normal communication developmental processes. The following courses are required for an emphasis in communication disorders: Sp Cm 212; CmDis 270, 275, 371, 376, 379, 385, 470, and 471; six more credits at the 300 level or above in communication disorders. In addition, the following courses are strongly recommended: ComSt 101; CmDis 171, 476, 479, 480, 485; Phys 198; Zool 155; Engl 314; Psych 230, 333; C I 204 and 406. In addition to this basic academic background, the student has an opportunity to observe and participate as a student clinician in the Iowa State University Speech-Language-Hearing Clinic and acquire up to 150 clock hours of undergraduate clinical practicum experience.

Successful completion of the preprofessional program prepares the student for professional graduate study in this field. A master's degree in communication disorders, additional supervised clinical practicum experience at the graduate level, a clinical fellowship year, and a written academic and clinical competency exam

are required beyond this program to practice the profession. A student must plan to attend another school for graduate work.

Graduate Study

The department offers the degrees master of science and doctor of philosophy in psychology, and a minor to students with a major in other departments. A two-year specialist degree program is offered in school psychology (NASP accredited).

Within the major of psychology, the department offers a doctoral specialization in counseling psychology (APA accredited) and areas of concentration in experimental psychology and applied individual differences, and social psychology.

Students seeking a graduate major in psychology must have graduated from an accredited college in a curriculum substantially equivalent to the undergraduate curriculum in Liberal Arts and Sciences at Iowa State University. Prerequisite to admission is at least 15 credits of basic psychology, which should include a laboratory course and a measurement-statistics course.

Graduates function as academic psychologists in higher education or as professional psychologists in applied settings. They have an extensive knowledge of psychological principles and the conceptual and quantitative skills to conduct psychological research, communicating the results to the scientific community, students in the classroom, and the general public. Graduates in applied programs have specialized knowledge in counseling and program development. They are skilled in delivering such programs and services to diverse clientele in a variety of settings.

The department also participates in the interdepartmental program in industrial relations and neuroscience, and in the interdepartmental minor in gerontology (see *Index*).

A formal class and a supervised practicum in the teaching of psychology is recommended for all doctoral students whose future plans may include teaching at the college level. A 12-month internship in a training site or agency approved by the faculty is required of all doctoral students in counseling psychology or school psychology.

The department also offers a B.S./M.S. program in psychology that allows the student to obtain both the B.S. and M.S. degrees in five years. Students interested in this program should contact the chair of the department's Graduate Program Committee. Application for admission to the Graduate College and department should be made near the end of the junior year of undergraduate study.

Courses open for nonmajor graduate credit: 401, 413, 422, 430, 436, 440, 450, 460.

Courses Primarily for Undergraduate Students

Psych 101. Introduction to Psychology. (3-0) Cr. 3. F.S.SS. Fundamental psychological concepts derived from the application of the scientific method to the study of behavior and mental processes. Applications of psychology. 101H: (2-2) F. Honors section. (For students in the University Honors Program only.)

Courses and Programs Psychology 313

Psych 102. Laboratory in Introductory Psychology. (0-2) Cr. 1. F.S. *Prereq: Credit or enrollment in 101.* Laboratory to accompany 101.

Psych 111. Orientation to Psychology. (1-0) Cr. R. F.S. Specialization areas and career opportunities within the field of psychology. Course selections and curricular tracks for specialization requirements. Required of psychology majors, but recommended for anyone considering psychology as a major. Offered on a satisfactory-fail grading basis only.

Psych 131. Academic Learning Skills. (0-2) Cr. 1. F.S. Efficient methods of study and reading. Offered on a satisfactory-fail grading basis only.

Psych 201. Exploring Psychology. (0-2) Cr. 1. F.S. Survey of psychological research and practice. Psychology majors only.

Psych 230. Developmental Psychology. (3-0) Cr. 3. F.S.SS. Life-span development of physical traits, cognition, intelligence, social and emotional behavior, personality, and adjustment.

Psych 280. Social Psychology. (3-0) Cr. 3. F.S.SS. Individual human behavior in social contexts. Emphasis on social judgments and decisions, attitudes, perceptions of others, social influence, attraction, aggression, and group pressure.

Psych 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Psych 301. Research Design and Methodology. (3-0) Cr. 3. F.S.SS. *Prereq: Stat 101; 1 course in psychology.* Survey of the principal research techniques used in psychology with an emphasis on the statistical analysis of psychological data.

Psych 302. Research Methods in Psychology. (2-2) Cr. 3. F.S. *Prereq: 301; Stat 101.* Discussion of and experience in designing research studies, collecting and analyzing data, and preparing research reports in psychology.

Psych 310. Brain and Behavior. (Same as Zool 310.) (3-0) Cr. 3. F.S.SS. *Prereq: 101; Biol 109 or 201 or Zool 155; Chem 163.* Survey of basic concepts in the neurosciences with emphasis on brain mechanisms mediating sensory processes, arousal, motivation, learning, and abnormal behavior.

Psych 312. Sensation and Perception. (3-0) Cr. 3. F.S.SS. *Prereq: 101.* Survey of the physiology and psychology of human sensory systems including vision, audition, smell, taste, the skin senses, and the vestibular senses.

Psych 313. Learning and Memory. (3-0) Cr. 3. F.S.SS. *Prereq: 101.* Fundamental concepts and theories of learning and memory derived from human and animal research.

Psych 314. Motivation. (3-0) Cr. 3. F.S.SS. *Prereq: 101.* Concepts and topics of motivation including curiosity, pain, emotion, sex, aggression, love, play, addiction, sleep, fatigue, and work.

Psych 315. Drugs and Behavior. (3-0) Cr. 3. F.S. *Prereq: 101; Biol 109 or 201 or Zool 155.* Fundamentals of psychoactive drugs and their use in experimental, therapeutic, and social settings.

Psych 316. Cognitive Processes. (3-0) Cr. 3. F.S.SS. *Prereq: 101.* Human information processing during thinking, problem solving, reading and language. Fundamental processes in perceiving, coding, storing, and retrieving information from short-term and long-term memory, including underlying brain mechanisms.

Psych 333. Educational Psychology. (Same as C I 333.) See *Curriculum and Instruction*.

Psych 346. Psychology of Women. (Same as W S 346.) (3-0) Cr. 3. S. *Prereq: 2 courses in psychology including 101.* Survey of psychological literature relating to biological, developmental, interpersonal, and societal determinants of the behavior of women.

Psych 360. Psychology of Normal Personality. (3-0) Cr. 3. F.S.SS. *Prereq: 101.* Theories and research in

the study of development and functioning of normal personality.

Psych 381. Social Psychology of Small Group Behavior. (Same as Soc 381.) (3-0) Cr. 3. S. *Prereq: 280 or Soc 305.* A survey of small group research and theory from a social psychological perspective. Major theories of interpersonal behavior such as exchange theory, equity theory, and status consistency theory, and major areas of research such as leadership, power, conformity, bargaining, status, norms, and roles.

Psych 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Psych 401. History of Psychology. (3-0) Cr. 3. F.S. *Prereq: 4 courses in psychology.* Philosophy and science backgrounds of psychology. Development of theories and causes of events in academic and applied psychology. Nonmajor graduate credit.

Psych 413. Psychology of Language. (Same as Ling 413.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 101.* Psychological and linguistic processes involved in language related activities, like speaking, listening, reading and writing. Nonmajor graduate credit.

Psych 422. Counseling Theories and Techniques. (2-2) Cr. 3. F.SS. *Prereq: 3 courses in psychology.* Survey of major theoretical approaches in counseling and related assessment and treatment techniques. Supervised practice in basic counseling skills. Nonmajor graduate credit.

Psych 430. Psychology of Adolescence. (Same as C I 430.) See *Curriculum and Instruction*.

Psych 434. Applied Behavior Analysis. (Dual-listed with 534.) (3-0) Cr. 3. *Prereq: 9 credits in human development and family studies or psychology.* Design and evaluation of behavioral interventions in applied settings such as classrooms, institutions, and families. Design of single subject experiments.

Psych 436. Individual Differences and Exceptional Patterns of Development. (3-0) Cr. 3. S. *Prereq: 230.* Behaviors, abilities, and needs of retarded, gifted, handicapped, and other atypical persons; differences associated with race, sex, and socio-economic status. Nonmajor graduate credit.

Psych 437. Characteristics of Giftedness. (Dual-listed with 537; same as HD FS 437.) (3-0) Cr. 3. *Prereq: 9 credits in human development and family studies or psychology, including Psych 230 or HD FS 102; junior classification.* Understanding of giftedness and talent from cognitive, developmental, and social perspectives using a life-span approach. Current conceptualizations and research regarding gifted children and adults. Implications for education and guidance.

Psych 440. Psychological Measurement I. (2-2) Cr. 3. F.S.SS. *Prereq: 301 and 9 credits in psychology, Stat 101.* Principles of psychological measurement, including concepts of reliability and validity; interpretation of scores; factors influencing performance; construction and use of measures of ability, achievement, and personality. Nonmajor graduate credit.

Psych 450. Industrial Psychology. (3-0) Cr. 3. F.S.SS. *Prereq: 2 courses in psychology including 101, Stat 101.* Content and methods of industrial psychology. Selection and placement techniques, performance appraisal, training, testing in industry, techniques of interviewing, human error, accidents, and job analysis. Statistics including regression and correlation are used throughout the course. Nonmajor graduate credit.

Psych 460. Abnormal Psychology. (3-0) Cr. 3. F.S.SS. *Prereq: 3 courses in psychology including 101.* Description of major forms of maladaptation including anxiety, mood disorders, and schizophrenia. Factors in the development of behavior deviations. Research pertinent to the description, development, and maintenance of abnormal behavior. Nonmajor graduate credit.

Psych 470. Seminar in Psychology. (1-0 to 3-0) Cr. 1 to 3 each time taken. *Prereq: 12 credits in psycholo-*

gy. Current topics in psychological research and practice.

- A. Counseling
- B. Experimental
- C. Individual Differences
- D. Social

Psych 484. Psychology of Close Relationships. (3-0) Cr. 3. S. *Prereq: 9 credits in psychology including 280.* Theories and research concerning the functions, development, and deterioration of close relationships. Influence of psychological processes on friendship, romantic, marital, and family relationships. Topics include mate selection, interdependence, trust and commitment, power and dominance in relationships, sexuality, divorce, gender roles, and family interaction.

Psych 485. Health Psychology. (3-0) Cr. 3. F. *Prereq: Junior classification, 6 credits in psychology.* Application of psychological theory and research methods to issues in physical health. Psychological factors in illness prevention, health maintenance, treatment of illness, recovery from injury and illness, and adjustment to chronic illness.

Psych 488. Cultural Psychology. (3-0) Cr. 3. S. *Prereq: 280 and 301; junior classification.* Examination of psychological differences among people living in different parts of the world with a focus on cross-cultural research related to social, developmental, and personality psychology.

Psych 490. Independent Study. Cr. var., maximum 3 per semester. F.S.SS. *Prereq: Junior classification, 6 credits in psychology, and permission of instructor.* No more than 9 credits of 490 may be counted toward a degree in psychology. Supervised reading in an area of psychology. Writing requirement.

Psych 491. Research Practicum. Cr. var. F.S.SS. *Prereq: Junior classification, permission of instructor, and credit or enrollment in 301.* No more than 9 credits of 491 may be counted toward a degree in psychology. Supervised independent research in an area of psychology. Primarily for students intending to pursue graduate education.

Psych 492. Fieldwork Practicum. Cr. var. F.S.SS. *Prereq: Junior classification, 12 credits in psychology, and permission of instructor.* No more than 9 credits of 492 may be counted toward a degree in psychology. Supervised fieldwork in a human service agency or other appropriate setting. Offered on a satisfactory-fail grading basis only.

Psych 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Psych 507. Applications of Multivariate Methods in Psychology. (3-0) Cr. 3. *Prereq: Stat 401, Stat 402.* Training in the application of multivariate methods in the analysis of psychological data using standard statistical packages. Techniques that are covered include exploratory and confirmatory factor analysis, MANOVA, multiple regression models, logistic regression, survival analysis, path analysis, and structural equation analysis with latent variables.

Psych 508. Research Methods in Applied Psychology. (3-0) Cr. 3. S. *Prereq: 440, Stat 401.* Methods and issues in applied psychological research. Role of theory in research, fidelity of measurement, selection of subjects, sampling, ethical issues, experimenter bias, data collection methods, power analysis, meta-analysis, and professional standards for writing research articles. Emphasis on research methodological issues, not statistical issues.

Psych 511. Advanced Physiological Psychology. (3-0) Cr. 3. *Prereq: 310.* Neurophysiological correlates of behavior.

Psych 512. Advanced Perception. (3-0) Cr. 3. *Prereq: 312.* Survey of current theory and research in perception with an emphasis on vision.

Psych 514. Advanced Human Learning and Memory. (3-0) Cr. 3. *Prereq: 313 or 316 or 9 hours in psychology.* Historical and contemporary survey of human learning and memory.

Psych 516. Advanced Cognition. (3-0) Cr. 3. *Prereq: 316.* Theoretical models and empirical research in human cognition, including pattern recognition, attention, visual imagery, text processing, short-and long-term memory, problem solving, decision making, language, and hemispheric specialization.

Psych 517. Psychopharmacology. (3-0) Cr. 3. *Prereq: 310, and permission of instructor.*

Fundamentals of drug-behavior interactions with emphasis on psychoactive drugs and their use in experimental, therapeutic, and social settings.

Psych 519. Cognitive Neuropsychology. (3-0) Cr. 3. *Prereq: Permission of instructor.* Psychological models and related neurological substrates underlying cognition in normals and brain-damaged patients. Topics of investigation include spatial perception, object and face recognition, voluntary motor control, language processing, memory, and problem solving.

Psych 530. Life Span Developmental Psychology. (3-0) Cr. 3. *Prereq: 4 courses in psychology, including 230.* Psychological changes in human behavior from conception to senescence in physical, sensory, intellectual, emotional, and social development. Intensive consideration of theories, issues, and data central to a life-span model of development; major longitudinal studies emphasized.

Psych 533. Psychology of Learning, Cognition, and Motivation in Educational Settings. (Same as C I 533.) See *Curriculum and Instruction*.

Psych 534. Applied Behavior Analysis. (Dual-listed with 434.) (3-0) Cr. 3. *Prereq: 9 credits in human development and family studies or psychology.* Design and evaluation of behavioral interventions in applied settings such as classrooms, institutions, and families. Design of single subject experiments.

Psych 536. Psychology of Mild Disabilities. (3-0) Cr. 3. *Prereq: 436 or graduate classification.*

Psychological characteristics of the mildly handicapped including persons with mild mental retardation, learning disabilities, and behavior disorders. Theory and research concerning etiology, prevalence, diagnosis, learning, adjustment, treatment, and education programming.

Psych 537. Characteristics of Giftedness. (Dual-listed with 437; same as HD FS 537.) (3-0) Cr. 3. *Prereq: 9 credits in human development and family studies or psychology, including Psych 230 or HD FS 102; junior classification.* Understanding of giftedness and talent from cognitive, developmental, and social perspectives using a life-span approach. Current conceptualizations and research regarding gifted children and adults. Implications for education and guidance.

Psych 538. Developmental Disabilities in Children. (Same as HD FS 538.) (3-0) Cr. 3. *Prereq: 9 credits in human development and family studies or psychology.* Theories, research, and current issues regarding development in children with disabilities. Investigation of interventions with children and families.

Psych 540. Psychological Measurement II. (3-0) Cr. 3. *Prereq: 9 credits in psychology, 3 credits in statistics, and permission of instructor or graduate classification in psychology.* Nature of psychological measurement. Measurement and scaling theory. Theoretical and statistical definitions of reliability and validity. Test and scale construction strategies.

Psych 542. Psychoeducational Assessment. (3-0) Cr. 3. F. *Prereq: 440.* Theory and research concerning assessment of intelligence and achievement with emphasis on developmental patterns and diagnosis of learning problems. Critical examination of current assessment practices in clinical and educational settings.

Psych 544. Practicum in Assessment. *Prereq: 542 and permission of instructor.* Supervised practice in designing and implementing observational systems and in administering, scoring, interpreting, and reporting individual tests.

A. Behavioral Assessment (2-1) Cr. 2.

B. Individual Tests: Children (2-1) Cr. 2.

C. Testing: Adult Ages (0-2) Cr. 1.

Psych 545. Individual Differences. (3-0) Cr. 3. *Prereq: 540.* Psychometric assessment of human attributes (abilities, personality, and vocational interests) and their role as behavioral determinants in school, work, and interpersonal settings. Methodological issues encountered in the assessment of psychological traits (construct validity) and the developmental etiology of these attributes (nature/nurture).

Psych 546. Human Abilities. (3-0) Cr. 3. *Prereq: 540.* Analyses of conceptual issues and empirical findings on human abilities from differential psychology. Applied and theoretical topics will receive commensurate attention, but the forecasting efficiency of human abilities in business, counseling, educational, and industrial contexts will be given particular emphasis.

Psych 550. Advanced Industrial and Organizational Psychology. (3-0) Cr. 3. *Prereq: 440, Stat 402.* Critical examination of theories, methods, and applications in industrial and organizational psychology. History and legal issues, predictor and criteria relationships, employee attitudes and behaviors, employee training and motivation, and human factors.

Psych 560. Advanced Personality Psychology. (3-0) Cr. 3. *Prereq: 4 courses in psychology, including 360.* Analysis of theories of personality, concepts, methods, and current research issues.

Psych 561. Psychopathology and Behavior Deviations. (3-0) Cr. 3. S. *Prereq: 460.* Critical review of theoretical perspectives and current research on the development and maintenance of the major forms of maladaptation including schizophrenic, anxiety, affective, drug use, personality, psychosexual, reactive, and childhood disorders.

Psych 562. Personality Assessment. (3-0) Cr. 3. *Prereq: 360, 440, Stat 401.* Principles, concepts, and methods of personality assessment. Though not a practicum course, exposure is given to a variety of objective, projective, and situational tests.

Psych 563. Developmental Psychopathology. (3-0) Cr. 3. *Prereq: 230 and 460 or graduate classification.* Theory and research related to major disorders of childhood and adolescence with an emphasis on assessment, etiology, and developmental processes, and multimodal interventions.

Psych 580. Advanced Social Psychology: Psychological Perspectives. (3-0) Cr. 3. *Prereq: 4 courses in psychology, including 280.* Current theories, methods, and research in social psychology with an emphasis on cognitive and interpersonal processes such as attribution, social cognition, attitude change, attraction, aggression, and social comparison.

Psych 581. Applications of Social Psychology Theories. (3-0) Cr. 3. *Prereq: 12 credits in psychology, including 280.* Application of social psychological theory to various applied topics, including physical and mental health, stress, and coping.

Psych 586. Research Methods in Social Psychology. (3-0) Cr. 3. *Prereq: Stat 402 and permission of instructor.* Ethical issues, generating testable hypotheses, operationalizing independent and dependent variables, sampling and design issues, laboratory procedures, and interpretation of results in experimental research. Issues in analysis of variance, Bayesian reasoning, and effect size estimation will be emphasized, as will writing and publication strategies.

Psych 590. Special Topics. Cr. var. *Prereq: 12 credits in psychology, and permission of instructor.* Guided reading on special topics or individual research projects.

- A. Counseling
- B. Industrial/Organizational
- C. School Psychology
- D. Individual Differences
- E. Experimental
- F. Educational
- G. Physiological
- I. Abnormal
- K. Developmental

L. Exceptional Children

M. Consumer

N. Social

O. Personality

P. Psychometrics

Psych 593. Advanced Workshop in Psychology. Cr. var. Intensive examination of a particular topic in psychology.

Psych 597. Internship in Psychology. Cr. R. *Prereq: M.S. or specialist degree candidacy in the program area through which the internship is sought; permission of instructor.* Full-time supervised experience in a school, human services, or other setting relevant to one of the fields of psychology listed below. Intended for masters or specialist level internships.

- A. School
- B. Experimental

Courses for Graduate Students

Psych 601. History of Philosophy of Psychology. (3-0) Cr. 3. *Prereq: 4 courses in psychology.* Origins of psychology in philosophical, medical, and related thought. Development as an independent discipline in the nineteenth and twentieth centuries as a science and as a practice including traditional and contemporary theory and philosophy.

Psych 621. Psychological Counseling: Theory and Process. (2-0) Cr. 2. F. *Prereq: 4 courses in psychology including 440 and 460, and permission of instructor.* Combined survey of theoretical issues and approaches. Didactic coverage of theoretical viewpoints at an introductory level.

Psych 621L. Techniques in Counseling. (0-6) Cr. 3. F. *Prereq: 621 or concurrent enrollment in 621 and permission of instructor.* Development of basic counseling skills and techniques through observation, role-playing, case studies, and supervised counseling sessions.

Psych 623. Vocational Behavior. (3-0) Cr. 3. *Prereq: 3 courses in psychology.* Theoretical views, research, and issues in career development through the life span. Methods of career counseling, including appraisal interviewing, assessment, test interpretation, and use of information sources.

Psych 626. Group Counseling. (2-2) Cr. 3. *Prereq: 621L, 691A.* Theory, research, ethical issues, and therapeutic considerations relevant to group counseling. Participation in lab exercises for development of group counseling skills and observation of ongoing groups.

Psych 628. Advanced Counseling Theory. (2-0) Cr. 2. *Prereq: Practicum in counseling psychology.* In-depth coverage of major theoretical positions, including comparative analysis. Coverage and evaluation of research on counseling interventions.

Psych 633. Teaching of Psychology. (2-0) Cr. 2. *Prereq: Enrollment in degree program in psychology, completion of at least 1 year of graduate study, permission of instructor.* Orientation to teaching of psychology at college level: academic issues and problems, instructional and evaluative techniques.

Psych 634. Behavior Therapy and Consultation. (2-2) Cr. 3. *Prereq: 534 or graduate classification and permission of the instructor.* Advanced consideration of behavioral approaches to consultation and therapy with emphasis on treatment of children and youth with externalizing disorders, parent training, and system change.

Psych 635. Interventions with Children and Adolescents. (3-0) Cr. 3. *Prereq: Graduate classification and permission of the instructor.* Research and theory underlying application of behavioral and cognitive psychology to the treatment of childhood and adolescent psychopathology with an emphasis on internalizing disorders, developmental processes, and multimodal interventions.

Psych 650. Advanced Topics in Industrial-Organizational Psychology. (3-0) Cr. 3. *Prereq: 540, 550, and permission of instructor.* Recent developments and advanced topics in I/O psychology. Attitude-behavior relations, organizational development, performance measurement, scale construction

tion, meta-analysis, and training. May be repeated for credit.

Psych 691. Practicum in Psychology. Cr. var. *Prereq: Permission of instructor.* Supervised practice and experience in the following fields of specialization in applied psychology:

- A. Counseling
- B. Industrial-Organizational
- C. School Psychology
- D. Individual Differences
- E. Group Counseling. *Prereq: 626, 691A (satisfactory-fail grading basis only)*
- F. Advanced Counseling. *Prereq: 691A (satisfactory-fail grading basis only)*
- T. Teaching. *Prereq: 633 (satisfactory-fail basis grading only)*

Psych 692. Seminar in Psychology. (1-0 to 3-0) Cr. 1 to 3 each time taken. *Prereq: 12 hours in psychology.*

- A. Counseling
- B. Industrial-Organizational
- C. School Psychology
- D. Individual Differences
- E. Experimental
- F. Educational
- G. Physiological
- I. Abnormal
- K. Developmental
- M. Professional Issues and Ethics
- N. Social
- O. Personality
- P. Psychometrics
- R. Child and Family Interventions
- S. Child/Adolescent Psychopathology
- T. Longitudinal Research/Gifted

Psych 697. Internship in Psychology. Cr. R. *Prereq: Ph.D. candidacy in the program area through which the internship is sought; permission of instructor.* Full time supervised predoctoral internship experience in a school, human service agency, or other setting relevant to one of the following fields of psychology:

- A. Counseling
- B. Industrial-Organizational
- C. School
- D. Experimental

Psych 699. Research. Offered on a satisfactory-fail grading basis only.

Communication Disorders (CmDis)

(Administered by the Department of Psychology)

The following courses are part of the Speech Communication program. For more information refer to that section. CmDis 170, 171, 270, 275, 286, 290, 371, 376, 379, 385, 404, 470, 471, 476, 479, 480, 485, 490, 493, 499, 504, 590.

Communication Disorders (CmDis)

Courses Primarily for Undergraduate Students

CmDis 170. Speech Improvement for Nonnative Speakers. (2-0) Cr. 2. F.S.SS. For nonnative speakers of English only. Development of effective English vowel and consonant productions, accommodation processes that occur in context, intelligibility in conversational English, and appropriate stress patterns. Offered on a satisfactory-fail grading basis only.

CmDis 171. Improving Speech Effectiveness. (Same as Sp Cm 171.) (2-0) Cr. 2. For native speakers of English only. Development of effective professional speech behaviors: voice quality; articulation, pronunciation, language skills; and fluency applied to conversational and extemporaneous speech. Assignment options available for those in broadcast journalism.

CmDis 270. Speech and Hearing Mechanism. (Same as Ling 270.) (3-0) Cr. 3. F. Anatomy and physiology of respiration, phonation, articulation, and hearing.

CmDis 275. Introduction to Communication Disorders. (Same as Ling 275.) (3-0) Cr. 3. F.SS.

Survey of nature, causes, and types of major communication disorders including phonological, adult and child language, voice, cleft palate, fluency, and hearing disorders.

CmDis 286. Basic Sign Language. (Same as Ling 286.) (3-0) Cr. 3. SS. Development of basic skills in the use and understanding of signed English, a modification of American Sign Language. Overview of the types, causes and consequences of hearing impairment, deaf culture and the education of hearing-impaired children.

CmDis 371. Phonetics and Phonology. (Same as Ling 371.) (3-0) Cr. 3. S. *Prereq: 275 or Engl 219.* Analysis of speech through study of individual sounds, their variations, and relationships in context; English phonology; practice in auditory discrimination and transcription of sounds of American English; description of speech sounds in terms of their production, transmission, and perception.

CmDis 376. Articulation and Phonological Disorders. (Same as Ling 376.) (3-0) Cr. 3. F. *Prereq: 270, 275, 371.* Nature, etiology, assessment, and management of disorders of speech sound production. Overview of theories of normal and non-normal phonological development. Nonmajor graduate credit.

CmDis 379. Clinical Methods in Communication Disorders. (3-0) Cr. 3. S. *Prereq: 275 and 376 or 476 or 480.* Principles and methods used in the evaluation and treatment of communication disorders; preparation for clinical practicum. For those who plan a career in communication disorders.

CmDis 385. Audiology. (3-0) Cr. 3. F. *Prereq: 270, 275.* Nature, etiology, and assessment of hearing disorders. Materials fee. Nonmajor graduate credit.

CmDis 404. Seminar. (Dual-listed with 504.) Cr. 3 each time taken, maximum of 9. F.S.SS. *Prereq: 9 credits in communication disorders.*

CmDis 470. Speech and Hearing Science. (Same as Ling 470.) (3-0) Cr. 3. S. *Prereq: 270.* Acoustical and neurological bases of speech production and comprehension. Theories of speech production and perception. Nonmajor graduate credit.

CmDis 471. Language Development. (Same as Ling 471.) (3-0) Cr. 3. F. *Prereq: 275 or Psych 230 or Engl 219.* Definition of components of language. Overview of theories and developmental processes related to each component of linguistic skill (semantics, lexicon, syntax, morphology, phonology, pragmatics). Overview of normative information available for infants, children, adolescents, and adults. Attention to metalinguistic skills and the complementary nonlinguistic and paralinguistic skills. Nonmajor graduate credit.

CmDis 476. Voice and Fluency Disorders. (3-0) Cr. 3. SS. *Prereq: 270.* Nature, etiology, assessment, and management of voice and fluency disorders. Nonmajor graduate credit.

CmDis 479. Practicum in Communication Disorders. Cr. 1 to 2 each time taken, maximum of 4. F.S. *Prereq: 379; 376 or 476 or 480; permission of instructor.* Nonmajor graduate credit. Register for one of the following:

- A. Accent reduction
- B. Articulation and language disorders
- C. Voice and fluency disorders

CmDis 480. Language Disorders. (Same as Ling 480.) (3-0) Cr. 3. SS. *Prereq: 471 or 275.* Nature, etiology, assessment, and management of language disorders in children, adolescents, and adults. Overview of language development in special populations. Nonmajor graduate credit.

CmDis 485. Aural Habilitation. (3-0) Cr. 3. F. *Prereq: 275 or 385.* Educational, social, psychological, and communication consequences of hearing disorders. Nonmedical management of hearing impairment. Materials fee. Nonmajor graduate credit.

CmDis 490. Independent Study. Cr. 1 to 3 each time taken, maximum of 18. F.S.SS. Only one independent study enrollment is permitted within the department per semester. *Prereq: 9 credits in communication disorders, junior classification, permission of department chair.*

CmDis 493. Workshop. Cr. var. 1 to 3 each time offered. F.S. *Prereq: 12 credits in communication disorders.* Offered irregularly to explore special topics not adequately covered in other course offerings. Materials fee. Nonmajor graduate credit.

CmDis 499. Communication Internship. Cr. var. 1 to 3 each time taken, maximum of 6. F.S. *Prereq: 18 credits in communication disorders, other courses deemed appropriate by faculty adviser; cumulative GPA of at least 2.5 overall and 3.0 in communication disorders; and permission of the internship committee.* Supervised application of communication disorders information in professional settings.

Courses Primarily for Graduate Students, open to qualified undergraduates

CmDis 504. Seminar. (Dual-listed with 404.) Cr. 3 each time taken maximum of 9. F.S.SS. *Prereq: 9 credits in communication disorders.*

CmDis 590. Special Topics. Cr. 1 to 4 each time taken, maximum of 12 credits. F.S.SS. *Prereq: Permission of department chair.*

Sociology

socserver.soc.iastate.edu

Willis J. Goudy, Chair of Department

University Professors: Goudy

Professors: Blake, Bruton, Bystydzienski, Conger, C. Flora, J. Flora, Hoiberg, Hraba, Keith, Klonglan, Korsching, Lasley, Lee, Lorenz, Miller, Padgitt, Ryan, Schafer, Simons, Wells, Whitbeck, Woodman

Distinguished Professors (Emeritus): Beal, Warning

Professors (Emeritus): Bultena, Chang, Cohen, Mulford, Tait

Associate Professors: Aigner, Dobratz, Harrod, Hoyt, Jones-Johnson, Mazur, Roberts, Sapp, Sawyer

Assistant Professors: Anderson, Bell, Besser, Bird, Hinrichs, Litt, Munoz, Myers

Assistant Professors (Collaborators): Schor

Assistant Professors (Adjunct): Waggoner

Undergraduate Study

The department offers course work leading to either a bachelor of arts or bachelor of science in sociology. Additionally, a bachelor of science in Public Service and Administration in Agriculture is offered. The department offers course work for a minor in Criminal Justice Studies. Programs of study in sociology offered in both the College of Agriculture and the College of Liberal Arts and Sciences are outlined in this section. For the undergraduate curriculum in Liberal Arts and Sciences, with a major in sociology leading to the degrees of bachelor of arts and bachelor of science, see *Liberal Arts and Sciences, Curricula*. For the undergraduate curriculum in agriculture, with major in public service and administration in agriculture, leading to the degree bachelor of science, see *Agriculture, Curriculum in Public Service and Administration in Agriculture*. For the undergraduate curriculum in Liberal Arts and Sciences, with a minor in criminal justice studies, see *Liberal Arts and Sciences, Curriculum*.

Graduates understand how social institutions, communities, and organizations work and change; they can examine the causes and consequences of conformity, deviance, and inequality. They can apply sociological understanding of human behavior to practical work situations and everyday life. Graduates can read critically, think independently, and communicate effectively about social issues and social policy.

The department offers a minor in sociology which may be earned by completing 15 credits in sociology including 130 or 134; 3 credits from 201, 310, 380 or 420; 3 credits from 264, 305, or 381; and an additional 6 credits in sociology courses. At least 9 of the 15 credits must be at the 300 level or higher, 6 of these credits must be taken at ISU with a minimal grade of C.

College of Liberal Arts and Sciences—Sociology

A major in sociology can serve as a liberal arts education; as preparation for various positions in social service and related occupations in business and industry; as background for professional education in such areas as law and theology or as a basis for graduate professional training as a sociologist in academic, government, business, and industrial settings.

A program of study that meets the needs and interests of the student and department requirements will be developed in consultation with the major adviser. Programs of study will include 115, 130 or 134, 201 or 310 or 380 or 420, 302, 305, 327 or 330 or 331 or 332, 401, Stat 101, and Engl 302 or 309 or 314. Majors must complete an additional 12 credits in sociology at the 300 level or above. Majors must receive grades of C or better in Engl 104 and 105, and a grade of C or better in either Engl 302 or 309 or 314. If not exempted by the math placement exam, majors must complete Math 30. Programs leading to a bachelor of arts degree will emphasize additional coursework in groups I, II and IV of the general education requirements. Programs leading to a bachelor of science degree will emphasize additional coursework in groups III and IV of the general education requirements. Some of the possible fields of concentration are criminal justice systems, community (urban and rural) sociology, family sociology, sociology of work, social science teaching, research methods and statistics, social change and development, complex organizations, human population and ecology, social psychology, and sociological theory.

In consultation with their advisers, students may gain work experience and develop their skills in their field of concentration through the field observation and practice options of 454 and 460.

An accredited program of study resulting in a Bachelor of Arts degree in Social Work is available through a collaborative arrangement between Iowa State University and the University of Iowa School of Social Work. ISU students need to complete their lower division requirements, Sociology 261, and 12 credit hours in a concentration like sociology, human development and family studies, or psychology. Then they may transfer to the University of

Iowa for the upper division courses in Social Work which are available at both the University of Iowa School of Social Work's Des Moines Educational Center and the Iowa City campus. It is also possible for students to obtain a second bachelor's degree from Iowa State by combining a degree in Social Work from University of Iowa with a degree from Iowa State University. Interested students should see their department advisors for more specific, individualized guidance.

College of Agriculture—Public Service and Administration in Agriculture

The curriculum in public service and administration in agriculture is designed for students who desire an interdisciplinary education to pursue a career with agriculturally related governmental and private agencies, or with businesses and industries that are concerned with public services in agriculture. Students will explore the planning and implementing of rural and agriculturally related programs in organizations, communities (town, city, or county), multicounty areas, states, regions, and at the federal level.

The curriculum has a broad base of general education subjects including credits in communications, mathematics, physical and biological sciences, social sciences, and humanities. The technical subjects represent a combination of sociology, economics, government, and technical agriculture, with emphases on social and economic change, history of public services, complex organizations, interagency relationships, community leadership, community action, adoption and diffusion, group dynamics, and political and legal behavior as they relate to agriculture and rural areas.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in sociology and rural sociology and minor work for students majoring in other departments. For M.S. and Ph.D. departmental requirements, see Program of Graduate Study for Degrees in Sociology and Rural Sociology, available from the department office. The department offers concentrations in a number of areas, e.g., family, inequality, life course and aging; food systems, agriculture and environment; methodology; social change and development; social deviance and mental health; community studies and development; social organization; and social psychology. The Department of Sociology does not offer a non-thesis master's program.

Graduates have a broad understanding of sociology, address complex societal problems, and communicate effectively with scientific colleagues and the general public in both formal and informal settings. They understand sociological theory, conduct research, and are prepared to educate college students and contribute to public policy.

Although the department stipulates no language requirement for either the degree master of science or the degree doctor of philosophy, specifying competence in one or more languages may be desirable in some instances.

The department also participates in the inter-departmental program in industrial relations, interdepartmental majors in transportation and water resources, and interdepartmental minors in gerontology (see *Index*).

Courses open for nonmajor graduate credit: 377, 401, 411, 415, 420, 476.

Courses Primarily for Undergraduate Students

Soc 110. Orientation to Public Service and Administration in Agriculture. (1-0) Cr. R. F. Survey of public service and administration in agriculture. Exploration of career tracks and career planning. Recommended during first semester of freshman year or as soon as possible after transfer into the department.

Soc 115. Orientation to Sociology. (1-0) Cr. R. F. S. Orientation to sociology. Occupational tracks and career options open to sociology; introduction to career planning. Recommended during second semester of freshman year, or as soon as possible after transfer into the department. Offered on a satisfactory-fail grading basis only.

Soc 130. Rural Institutions and Organizations. (3-0) Cr. 3. F.S. An introductory analysis of sociological concepts and theories as they relate to rural institutions and organizations. Emphasis on the static structure and function of these institutions and organizations and on their dynamic adaptation to changing societal, environmental, and economic conditions. General sociological principles and perspectives. Credit for only 130 or 134 may be applied toward graduation.

Soc 134. Introduction to Sociology. (3-0) Cr. 3. F.S.SS. Social interaction and group behavior with emphasis on contemporary U.S. society, including issues relating to socialization, inequality, and changing rural and urban communities. Analysis of relationships among the institutions of family, religion, political participation, work, and leisure. Credit for only 130 or 134 may be applied toward graduation.

Soc 201. Social Organization. (3-0) Cr. 3. F.S. Prereq: 130 or 134. An overview of behavior existing at various levels of society (e.g., groups, organizations, institutions, communities, and nation states).

Soc 219. Sociology of Pre-Marital and Marital Relationships. (3-0) Cr. 3. F.S.SS. Prereq: 130 or 134. Sociological analysis of courtship and marriage relationships across the life cycle. Attention also given to alternative and single lifestyles, to parenting, and to family life.

Soc 235. Social Problems. (3-0) Cr. 3. F.S.SS. Prereq: 130 or 134. Sociological concepts and methods employed in the analysis of various social problems, including crime, substance abuse, problems with institutions, rural and urban problems, and international concerns. Consideration of various solutions.

Soc 241. Youth and Crime. (Same as CJ St 241.) (3-0) Cr. 3. F. Prereq: 130 or 134. An examination of delinquency that focuses on the relationship between youth as victims and as offenders, social and etiological features of delinquency, the role of the criminal justice system, delinquents' rights, and traditional and alternative ways of dealing with juvenile crime. Field trip fee.

Soc 261. Social Work, Social Welfare, and U.S. Society. (3-0) Cr. 3. S. Prereq: 130 or 134. An introduction to the social work profession and its relationship to the field of social welfare. Practice skills, settings and delivery systems; historical development, philosophy, values and issues in contemporary social work and social welfare.

Soc 264. Small Group Dynamics. (3-0) Cr. 3. F.S.SS. Prereq: 130 or 134. An introduction to intra- and inter-group dynamics in small groups. Group decision-making, coalitions, conformity, intergroup relations, status and role effects, leadership, group development and group conflict. Includes student participation in small group processes.

Soc 298. Cooperative Education. Cr. R. F.S.SS. Prereq: Permission of the department cooperative

Courses and Programs Sociology 317

education coordinator; sophomore classification. Required of all cooperative education students. Students must register for this course prior to commencing the work period.

Soc 302. Research Methods in Sociology. (2-2) Cr. 3. F.S. *Prereq: 130 or 134; Stat 101.* Introduction to research in sociology. Principles of scientific inquiries and basic understanding of research methods.

Soc 305. Social Psychology: A Sociological Perspective. (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* Examination of human behavior in a social environment with emphasis on development of the self, interpersonal relations, attitudes, and small groups.

Soc 310. Community. (3-0) Cr. 3. F.S. *Prereq: 130 or 134.* Comparative analysis of the institutional structure of rural, urban, and suburban communities; community as an ecological and social system; power relationships; analysis of planned and unplanned processes of social change.

Soc 325. Agriculture in Transition. (3-0) Cr. 3. S. The impacts of agricultural changes on farm families, rural communities, and consumers. Past, present, and future trends in family farms and their social implications.

Soc 327. Sex and Gender in Society. (Same as W S 327.) (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* How the biological fact of sex is transformed into a system of gender stratification. The demographics and social positions of women and men in the family, education, media, politics, and the economy. Theories of the social-psychological and sociological bases for behavior and attitudes of women and men. The relationship between gender, class, and race.

Soc 330. Ethnic and Race Relations. (Same as Af Am 330.) (3-0) Cr. 3. F.S.SS. *Prereq: 130 or 134.* Analysis of ethnic and race relations, particularly in America; emphasis on the sociology and psychology of race and ethnic relations.

Soc 331. Social Class and Inequality. (3-0) Cr. 3. F.S. *Prereq: 130 or 134.* Social stratification and processes resulting in poverty; implications of status, class, and poverty for people of different races, ethnicity, and gender.

Soc 332. The Latino/Latina Experience in U.S. Society. (3-0) Cr. 3. S. *Prereq: 130 or 134.* Socioeconomic and cultural experience and conditions of Latinos in the United States, with a focus on Chicanos, Puerto Ricans, and Cubans. Demographic and social conditions, including migration patterns and emerging Latino panethnicity.

Soc 340. Deviant and Criminal Behavior. (Same as CJ St 340.) (3-0) Cr. 3. S.SS. *Prereq: 130 or 134.* Theory and research on the etiology of types of social deviance; issues relating to crime, antisocial behavior and social policies designed to control deviant behavior.

Soc 341. Criminology. (Same as CJ St 341.) (3-0) Cr. 3. F.SS. *Prereq: 130 or 134.* The nature of crime and criminology; the concept of crime; statistics and theories of criminality; major forms of crime; official responses to crime and control of crime.

Soc 345. Population Problems and Society. (Same as Env S 345.) (3-0) Cr. 3. F. *Prereq: 130 or 134.* Human overpopulation; impact on food, resources, and services; population growth and development; trends of births, deaths, and geographic movement; projecting future population; population control and family planning; population policies and laws; comparison of the United States with other societies throughout the world.

Soc 377. Social Dimensions of Religion. (Same as Relig 377.) See *Religious Studies*. Nonmajor graduate credit.

Soc 380. Sociology of Work. (3-0) Cr. 3. F.S. *Prereq: 130 or 134.* Inequalities (gender, race, class) related to jobs, occupations, firms, and industries. Satisfaction, rewards, alienation, discrimination, and other topics of importance to workers are examined.

Soc 381. Social Psychology of Small Group Behavior. (Same as Psych 381.) (3-0) Cr. 3. S. *Prereq: Soc 305 or Psych 280.* A survey of small group theory

and research from an interdisciplinary, social psychological perspective.

Soc 382. Environmental Sociology. (Same as Env S 382.) (3-0) Cr. 3. F.S. *Prereq: Soc 130, 134 or Env S 207.* Environment-society relations; social construction of nature and the environment; social and environmental impacts of resource extraction, production, and consumption; environmental inequality; environmental mobilization and movements; U.S. and international examples.

Soc 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing the work period.

Soc 401. Contemporary Sociological Theories. (3-0) Cr. 3. F.S. *Prereq: 9 credits in sociology.* Both historical and modern social theories as applied to understanding and researching the social world. Nonmajor graduate credit.

Soc 411. Social Change in Developing Countries. (3-0) Cr. 3. S. *Prereq: 130 or 134 plus 3 credits in social sciences.* Social change and development in Third World countries; international interdependence; causes and consequences of persistent problems in agriculture, city growth, employment, gender equality, basic needs; local and worldwide efforts to foster social change and international development. Nonmajor graduate credit.

Soc 412. Senior Seminar on Career Development. (1-0) Cr. 1. F. *Prereq: Most of major core courses, senior classification.* Transition from student to professional. Career development procedures including self-assessment, short- and long-term goals, strategies for the job search, development of contacts and sources, resumes and interviews. Enrollment preferred in first semester as senior. Offered on a satisfactory-fail grading basis only.

Soc 415. Sociology of Technology. (3-0) Cr. 3. F. *Prereq: 130 or 134 plus 3 credits in social sciences.* Review of physical, biological, and social theories of technology and risk. Examination of risk perception, public responses, and differential rates of adoption of new technologies. Applications to topics in agriculture, development, and marketing. Nonmajor graduate credit.

Soc 420. Complex Organizations. (3-0) Cr. 3. F.SS. *Prereq: 130 or 134 plus 3 credits in social sciences.* Bureaucracies, organizations, and agencies as social systems. Internal processes. Influence of interpersonal and structural variables. Models of effectiveness. Linkages and networks. Importance of multinational organizations. Nonmajor graduate credit.

Soc 425. Social Movements and Revolution. (Dual-listed with 525.) (3-0) Cr. 3. Alt. SS., offered 2000. *Prereq: 6 credits in sociology.* Theoretical approaches and contemporary evidence of the origins, development, and impact of collective action, social movements, and revolutions: social-psychological, organizational, and structural dimensions; guerrilla movements; state repression and counterrevolution; post-revolutionary society; international comparisons.

Soc 435. Urban Sociology. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 130 or 134 plus 3 credits in social sciences.* Development of cities and urban systems; human and spatial ecology; urban transformation, decline, and revitalization; housing issues and homelessness; residential segregation; poverty; immigration and subcultures; urban social movements; local governance; alternative solutions and planning for cities; international comparisons.

Soc 450. Demographic Analysis, Projections, and Modeling. (Dual-listed with 550.) (3-0) Cr. 3. Alt. SS., offered 2001. *Prereq: 6 credits in sociology.* Methods and techniques for analyzing, projecting, and modeling demographic behavior and change. Focus on fertility, migration, and mortality; extensions made to aging, education, labor force, housing, service utilization, resource consumption, and consumer markets. Integrating population variables into planning processes. Applications using surveys, census data, and other indicators.

Soc 454. Field Observation and Practice. Cr. var., maximum of 12. F.S.SS. *Prereq: Junior or senior classification; permission of faculty internship coordinator; major or minor in sociology or PSA or 201, 302, 305.* Supervised practice in industrial plants, business organizations, and governmental agencies. Not more than 12 credits of field experience (Soc 454 and 460) may be counted toward meeting the required 47 credits of upper level courses and the total of 124.5 credits required for graduation. No credits in Soc 454 may be used to satisfy minimum sociology requirements for sociology majors. Offered on a satisfactory-fail grading basis only.

- A. General Sociology
- B. Rural Sociology

Soc 460. Criminal and Juvenile Justice Practicum. (Same as CJ St 460.) Cr. var., maximum of 12. F.S.SS. *Prereq: Junior or senior classification; permission of criminal justice studies coordinator; major or minor in sociology, criminal justice minor, or PSA; 241 or 340.* Study of the criminal and juvenile justice systems and social control processes. Supervised placement in a police department, prosecutor's office, court, probation and parole department, penitentiary, juvenile correctional institution, community-based rehabilitation program, or related agency. Not more than 12 credits of field experience (Soc 454 and 460) may be counted toward meeting the required 47 credits of upper level courses and the total of 124.5 credits required for graduation. No credits in Soc 460 may be used to satisfy minimum sociology requirements for sociology majors. Offered on a satisfactory-fail grading basis only.

Soc 461. Life Course Sociology. (3-0) Cr. 3. F. *Prereq: 6 credits in sociology.* Theoretical and empirical perspectives on individuals facing developmental tasks, age related norms, values, and subcultures. Decisions and issues faced by individuals as they progress through stages of the life cycle.

Soc 464. Community Action and Leadership. (3-0) Cr. 3. S.SS. *Prereq: 6 credits in sociology.* Methods of planning, organizing, and conducting planned social change and other action programs in communities. Strategies of change, change agent roles, client need identification, community organization strategies, citizen participation, leadership identification and development, program planning and evaluation.

Soc 473. Youth and Society. (Dual-listed with 573.) (3-0) Cr. 3. SS. *Prereq: 6 credits in sociology.* Analysis of problems of adolescents and youth created by the impact of changing institutional structure on the transition from childhood to adulthood.

Soc 476. The Aged in American Society. (Same as Geron 476.) (3-0) Cr. 3. S. *Prereq: 6 credits in sociology.* A survey of sociological problems of the aging and the social implications of a sizable aged population. Nonmajor graduate credit.

Soc 484. Topical Studies in Criminal and Juvenile Justice. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 6 credits in sociology and permission from instructor.* Thematic or topical issues and studies dealing with the sociology of police, judiciary, institutional and community-based corrections, gender/ethnicity and crime/delinquency, criminal and delinquent gangs, and crime and delinquency prevention.

Soc 485. Sociology of the Family. (3-0) Cr. 3. S. *Prereq: 6 credits in sociology.* The contemporary family in developing, industrial, and post-industrial societies. Effects of modernization and family policies on family structures and functions.

Soc 490. Independent Study. Cr. 1 to 3 each time taken. *Prereq: 6 credits in sociology and permission of instructor.* Students in the College of Agriculture must be of junior or senior classification and may use no more than 6 credits of Soc 490 toward the total of 128 credits required for graduation. Students in the College of Liberal Arts and Sciences may count no more than 9 credits of 490 toward graduation.

- A. General Sociology
- B. Rural Sociology
- H. Honors
- E. Senior Seminar

Soc 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification.* Required

of all cooperative education students. Students must register for this course prior to commencing the work period.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Soc 505. Historical Sociological Theory. (3-0) Cr. 3. F. *Prereq:* 401. Survey of the evolution of social thought from Ancient Greece through European Medieval and Renaissance eras with special emphasis on the Enlightenment. Focusing on the origins of positivism, conflict, and functionalist traditions, organicism, and sociology of knowledge perspectives.

Soc 511. Intermediate Research Methods. (2-2) Cr. 3. S. *Prereq:* 302, Stat 401. Research methods in sociology including problem selection, research design, hypothesis formulation, sampling, alternative measurement techniques; laboratory emphasis on application of methodologies to the design of a class research project; introduction to computer systems.

Soc 512. Sociological Measurement. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 511. Reliability and validity for observed and latent variables; exploratory and confirmatory factor analysis in the construction and evaluation of measurement models. Applications using LISREL, EQS, and other programs.

Soc 513. Qualitative Research Methods. (2-2) Cr. 3. Alt. F., offered 1999. *Prereq:* 511. Applied qualitative research methods in sociology. Design and implementation of a course-based research project including data collection, analysis, and presentation of results. Qualitative data gathering techniques using observational, historical, in-depth interviewing or content analysis approaches. Laboratory emphasis on completion of data gathering, analysis, and report writing.

Soc 517. Sociological Evaluation Methods. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 6 credits in sociology including 511. Examination of various methodological perspectives and procedures regarding the issues of validity, measurement, ethics, and the utilization of evaluative findings relevant to planned social action programs of governmental units and human service organizations.

Soc 520. Social Psychology: A Sociological Perspective. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 305 or Psych 280. Examination of cognitive, symbolic interaction, exchange, role-reference group, and dramaturgical approaches. Assessment of contemporary issues in social psychology.

Soc 521. Small Groups. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 305 or Psych 280. Examination of alternative theoretical models and methods of studying small groups.

Soc 522. Attitude and Attitude Change. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 305 or Psych 280. Analysis of theories of attitude and attitude change; current controversies between the theories examined, as well as supporting research.

Soc 525. Social Movements and Revolution. (Dual-listed with 425.) (3-0) Cr. 3. Alt. SS., offered 2000. *Prereq:* 6 credits in sociology. Theoretical approaches and contemporary evidence of the origins, development, and impact of collective actions, social movements, and revolutions: social-psychological, organizational, and structural dimensions: guerrilla movements; state repression and counterrevolution; post-revolutionary society; international comparisons.

Soc 528. Sociology of Gender. (Same as W S 528.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 6 credits in sociology. Examination of the social construction of gender and the social organization of gender inequality. Analysis of gender identity in socialization, interpersonal behavior, the media, and the economy. Investigation of the intersection of gender, race, and class.

Soc 529. Racial and Ethnic Inequality. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 6 credits in sociology. Analysis of racial and ethnic inequality in the United States and the world; focus on the implications of the changing world social and economic order for differences in racial and ethnic groups relative to wealth,

status, and power; a critical examination of majority-group domination of minority groups in various societies.

Soc 530. Social Organization. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 6 credits in sociology. Methodological and analytical issues associated with the study of group structure; contemporary theories of social organization.

Soc 532. Organizations and Their Environments. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 6 credits in sociology. Comparative analysis of complex organizations; complex organizations as semi-open systems. Interorganizational relations and organizational effectiveness.

Soc 533. Models of Community. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 6 credits in sociology. Emphasis on different models or frames of reference used in community analysis. Theoretical and methodological tools, current views of community problems, and explanation of social and cultural change are presented for each model.

Soc 534. Social Stratification. (3-0) Cr. 3. *Prereq:* 6 credits in sociology. Critical examination of the causes and consequences of social stratification and inequality; classical theories, contemporary frameworks, and recent empirical studies; international stratification patterns.

Soc 535. Urban Sociology. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 6 credits in social sciences. Theoretical, conceptual, and methodological approaches to understanding transformation of urban society in comparative perspective: interrelations among demographic, social, economic, and political dimensions of persistent urban problems and of urban development; examination of case studies.

Soc 540. Comparative Social Change. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 6 credits in sociology. Contemporary theories of social change, modernization, dependency, and development are critically examined; methodological issues identified; supporting research explored; applicability of theoretical models, concepts, and strategies to current national and international needs are evaluated.

Soc 541. Technological Innovation, Social Change, and Development. (Same as T SC 541, U St 541.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 6 credits in social sciences. Sources, theories and models of technological innovation, social, institutional, cultural, economic and political contexts of technology transfer; issues and methods of assessing impacts of technological change; planning technology related social change; local and international case studies.

Soc 542. Rural Development. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 6 credits in sociology. Sociological perspectives on contemporary theory and practice in rural development. Emphasis on the U.S. with international comparisons. Rural development approaches examined in a global context. The role of local, state, and national agencies, institutions of higher education, and the private sector in rural development will be assessed.

Soc 544. Sociology of Food and Agricultural Systems. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 6 credits in sociology. Social organization of food and fiber production, processing, and distribution systems. Sociological comparison of conventional and alternative production systems; gender roles in agriculture and food systems; local, national and global food systems; perspectives on food and agricultural research and policy.

Soc 545. Applied Sociology. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 512, 520, 530, Stat 401. Definitions of applied sociology. Consideration of the knowledge base, career options, and value dilemmas associated with the roles of planner, consultant, evaluator, and clinician.

Soc 548. Sociology of the Environment. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 6 credits in sociology. Social causes and social consequences of environmental problems. Interrelationship between social inequality and environmental inequality. Social construction and social experience of the environment. Contemporary developments in the social theory of

the environment. International and domestic implications.

Soc 549. Social Impact Assessment. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 6 credits in sociology. Conceptual, ethical, methodological, and policy issues in evaluating the effects of environmental and technological changes on communities and societies. Legacy of formal social impact assessment as conducted under the National Environmental Policy Act in the U.S. Social impacts of natural disasters, technological hazards, and development. Links to environmental equity analysis and community based assessment and monitoring. U.S. and international cases.

Soc 550. Demographic Analysis, Projections, and Modeling. (Dual-listed with 450.) (3-0) Cr. 3. Alt. SS., offered 2001. *Prereq:* 6 credits in sociology. Methods and techniques for analyzing, projecting, and modeling demographic behavior and change. Focus on fertility, migration, and mortality; extensions made to aging, education, labor force, housing, service utilization, resource consumption, and consumer markets. Integrating population variables into planning processes. Applications using surveys, census data, and other indicators.

Soc 561. Life Course Research. (Same as Geron 561.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 6 credits in sociology. A survey of current research and theory in life course sociology. The social antecedents and consequences of developmental transitions throughout the life course.

Soc 564. Community Action Practice and Theory. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 6 credits in sociology. Methods of planning, organizing, and conducting planned social change and other action programs in communities; strategies of change, change agent roles, client need identification, community organization strategies, citizen participation, leadership identification and development, program planning and evaluation.

Soc 566. Political Sociology. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 6 credits in sociology and/or political science. The relationship between state and society with emphasis on American society. Analysis of theoretical frameworks, political participation, power, social movements, elites, democracy, and capitalist society.

Soc 573. Youth and Society. (Dual-listed with 473.) (3-0) Cr. 3. SS. *Prereq:* 6 credits in sociology. Analysis of problems of adolescents and youth created by the impact of changing institutional structure on the transition from childhood to adulthood.

Soc 576. Sociological Perspectives on Aging. (Same as Geron 576.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 6 credits in sociology. Theoretical perspectives on the aging process; social and social-psychological changes accompanying aging; emphasis on research techniques and findings.

Soc 582. Theories of Social Deviance. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 6 credits in sociology. Theory and research regarding causes of and reactions to deviant behavior. Mental illness, homicide, family violence, and property crime are among the types of deviant behavior considered.

Soc 583. Sociology of Mental Health. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 6 credits in sociology. A review of contemporary sociological research and theory in mental health; social implications of the incidence and prevalence of mental disorders in various populations; the social antecedents and consequences of mental health.

Soc 584. Current Issues in Crime and Justice. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 6 credits in sociology. Discussion of current research and theory in crime and delinquency; topics include the purpose and role of law in social life; emerging theoretical directions in criminology; recent work on specific forms of criminality; controversies in the criminal justice system.

Soc 585. Contemporary Research in the Family. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 6 credits in sociology. A survey of current research in the family; emphasis on new methodologies and theories.

Soc 590. Special Topics. Cr. 1 to 3 each time taken. *Prereq: 6 credits in sociology; senior or graduate classification.*

- A. General Sociology
- B. Rural Sociology

Soc 591. Orientation to Sociology. (1-0) Cr. R. F. *Prereq: Formal admission into the sociology graduate program.* Introduction to the department, current graduate student policies at department and university levels, departmental administrative procedures. Required of graduate students. Offered on a satisfactory-fail grading basis only.

Soc 592. Teaching Sociology. (3-0) Cr. 3. F. *Prereq: Graduate classification in sociology.* Pedagogical and substantive issues in the teaching of sociology at the college level focusing on course organization, instructional objectives, techniques of presentation, and instruments for evaluation of learning and instruction.

Soc 593. Workshops. Cr. 1 to 3.

- A. General Sociology
- B. Rural Sociology

Soc 595. Internship. Arr. Cr. 6 to 9. F.S.SS. *Prereq: 12 graduate credits in sociology, approval of major professor and internship coordinator.* Supervised practice for students to apply sociological knowledge and skills to work with client groups.

Soc 599. Research for Master's Thesis.

- A. General Sociology
- B. Rural Sociology

Courses for Graduate Students

Soc 607. Contemporary Sociological Theory. (3-0) Cr. 3. S. *Prereq: 6 graduate credits in sociology.* Survey of theoretical developments since 1925, including the rise of structural-functionalism, symbolic interactionism, conflict theories, phenomenology, exchange theory, and others.

Soc 611. Advanced Theory Construction for Categorical Outcomes. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: 511; Stat 404.* Rationale for and interpretation of various quantitative methods of analyzing categorical and ordered categorical variables, including log-linear, logit, logistic, and event history analysis; models for censored data.

Soc 613. Advanced Theory Construction and Causal Modeling. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 512 and Stat 404.* Formal strategies of research design and analysis using structural equations with latent variables. Strategies for the analysis of multi-informant and panel data, with emphasis on distributional problems and diagnostics.

Soc 642. Sociology of Adoption and Diffusion. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 6 graduate credits in sociology.* Sociological and social-psychological theories related to adoption and diffusion of new ideas; analysis of adoption and diffusion models; methods of field research; factors related to rates and intensity of adoption and diffusion; adopters' characteristics related to rates of adoption.

Soc 643. Issues in Food Systems, Agriculture, and the Environment. (3-0) Cr. 3. *Prereq: Soc 544 or 548.* An advanced seminar examining current topics in the sociology of food, the sociology of agriculture and food systems, and environmental sociology, with attention to themes and questions unifying and distinguishing these domains. Emphasis on current theoretical, empirical and methodological issues in the field.

Soc 645. Sociology and Policy Analysis. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 545.* Application of sociological theories and methods for conducting policy research. The interaction between the political process and the role of policy research in problem definition, policy design and policy implementation as viewed from alternative paradigms: ethical issues associated with conducting research in a policy setting and for setting a public policy agenda.

Soc 670. Current Issues in Community. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: Two of the following: Soc 533, 535, 564.* An advanced seminar examining current topics in the sociology of urban and rural communities. Emphasis on current theoretical, empirical, and methodological issues in the field and how those

issues are linked to current practice of community building.

Soc 675. Current Topics in Family and the Life Course. (3-0) Cr. 3. F. *Prereq: 6 credits in sociology.* An advanced seminar on current developments in a selected area of study in the sociology of family and the life course. Deals with theoretical, empirical, and methodological issues.

Soc 698. Seminars in Sociology. (3-0) Cr. 3 each.

- A. Family, Life Course, and Aging
- B. Methodology
- C. Community
- D. Social Change and Development
- E. Social Deviance
- F. Social Issues and Public Policy
- G. Social Organization
- H. Social Psychology
- I. Inequality

Soc 699. Dissertation Research.

- A. General Sociology
- B. Rural Sociology

Speech Communication

(Administered by the College of Liberal Arts and Sciences)

Undergraduate Study

The cross-disciplinary program in speech communication offers introductory courses designed for all students as part of their general education, as a complement to professional training, and as an introduction to further study within the discipline.

Students who major or minor in speech communication can prepare themselves for a wide variety of future employment opportunities, depending upon individual interests, background, and abilities. Present curricula can prepare students for the study of law or theology; for positions in business and industry or education; and for graduate level work in speech communication, speech-language pathology and audiology, communication studies, or related disciplines.

A student electing to major in speech communication must meet the particular requirements of one of the following options: communication studies, interpersonal and rhetorical communication, or speech education (bachelor of arts).

General requirements for majors in speech communication are as follows: (1) completion of all credits used to meet a particular curriculum's requirements with a grade of 2.0 or better; and (2) no credits in 290, 490, 493, 499, and 590 may be applied toward the minimum required credits within any prescribed option. (ComSt: 33 credits; IRC: 33 credits; SpEd: 47 credits.) Specific requirements for the major in speech communication with its various options are listed under their respective descriptions.

For all options except communication studies, the English proficiency requirement may be met by (1) completion of Engl 104, 105 (or 105H), or its equivalent, with a grade in each of 2.0 or better; (2) one additional writing course beyond Engl 105 with a grade of 2.0 or better from the following approved list: Engl

302-305, 309, 314, 415; JI MC 201. For communication studies students completion of Engl 104, 105 (or 105H) with 2.0 or better and 2.0 in one additional course from this list: Engl 302, 309, 314, 415.

The requirements for minors in speech communication may be fulfilled by credit in ComSt 101 and/or Sp Cm 212 (whichever is appropriate) plus at least 15 additional hours, of which 9 credits are in courses numbered 300 or above. All 15 credits must be taken within either communication studies or interpersonal and rhetorical communication. All credits taken for the minor must have a grade of 2.0 or higher. No credits in 290, 490, 493, 499, and 590 may apply toward the minor.

The program participates in the following interdisciplinary undergraduate minor programs: the interdisciplinary program in linguistics, and the interdisciplinary program in technology and social change, and the undergraduate program in gerontology.

Speech Communication Education

Students fulfilling the requirements for teacher licensure prepare to teach speech communication, dramatic arts, and media at the secondary school level. In addition, they prepare to direct co-curricular and extracurricular activities.

Each student seeking teacher licensure in speech communication must fulfill the requirements outlined in the Teacher Education section of this bulletin. In addition, each student must maintain a 2.5 grade point average in all courses taken to be admitted to the College of Education.

Communication Studies (ComSt)

The communication studies program is a focused course of inquiry into the contemporary study of human communication. This program emphasizes applied communication theory and research in interpersonal, small group, organizational, and intercultural communication.

A communication studies option prepares students for graduate education and careers in business and industry. Students emphasizing communication studies should find their career opportunities enhanced in professions requiring applied communication expertise, e.g., human resource management, personnel, training and development, sales, management, public relations, organizational development, public information, business communication, and international and intercultural relations.

The following courses are required for an emphasis in communication studies: ComSt 101, 102, 203, 310, 311, 314, 317, 497; JI MC 401 and 6 additional hours in the area (see adviser for list of approved courses); Stat 101; Engl 302 or 309 or 314 or 415; plus 6 hours in an allied discipline (see adviser for list of approved courses).

Interpersonal and Rhetorical Communication (Sp Cm)

The interpersonal and rhetorical communication area provides a thorough understanding of communication theories, principles, and applications. Students will be required to complete courses which provide a solid grounding in the theories of communication, the nature of

rhetorical principles in communication, and the role of communication in creating, maintaining, and changing human relationships. The following courses are required for an emphasis in interpersonal and rhetorical communication: ComSt 101; Sp Cm 212, 305, 327, 412, and 497 (Senior Seminar) plus an additional 15 credits from courses in interpersonal and rhetorical communication (Sp Cm).

Emphasis in the area prepares students for graduate study, the study of law or theology, to teach speech communication in high school, or enter a variety of communication-related careers and occupations in business and professional organizations. Communication internships in business and professional settings are available for qualified students. The area's courses also provide a minor concentration for students in business, English, journalism, foreign languages and literatures, and the social sciences.

Communication Disorders (CmDis)

The Communication Disorders curriculum, previously administered by Speech Communication, is now administered by the Department of Psychology. Students interested in a broad-based education centered around normal and non-normal communication, as well as students interested in careers in Speech-Language Pathology or Audiology, can pursue studies in Communication Disorders. A student must enroll in the Liberal Arts and Sciences Interdisciplinary Studies Major, then indicate Communication Disorders as the theme of his/her curriculum for his/her Bachelor of Science degree. This area of interest will then be indicated on the student's diploma. The major includes 36 to 48 credits of coursework from across two or more academic disciplines, with a minimum of 18 credits in Communication Disorders and a minimum of 18 credits in one or more other areas. A student, in consultation with a member of the Communication Disorders faculty, writes a letter of application that overviews his/her academic aims and includes his/her intended curriculum. An Interdisciplinary Studies review board then screens and approves this application. Specific information about the content of this application and the requirements for the Interdisciplinary Studies Major is located under *Interdisciplinary Studies* in this Bulletin.

Students interested in Speech-Language Pathology or Audiology will obtain the academic preparation for graduate studies in these areas. In addition, students will have opportunities to observe and participate as student clinicians in the Iowa State University Speech-Language Clinic. To become certified by the American Speech-Language-Hearing Association and/or licensed by a state in either one of these fields, students must earn a graduate degree with both academic and clinical components, complete a Clinical Fellowship Year, and pass a national examination. Students must plan to attend another school for their graduate studies.

Theatre

The theatre program is administered by the Department of Music, (see *Index*).

Graduate Study

The program offers courses for a graduate minor in speech communication as well as supporting work for other disciplines. The Program of Speech Communication also participates in the interdepartmental program leading to a master's degree in Interdisciplinary Graduate Studies.

Within the speech communication graduate minor, a student may elect a general program of study or concentrate in one of the three areas of emphasis: communication disorders, communication studies, or interpersonal and rhetorical communication.

Courses open for nonmajor graduate credit: CmDis 376, 385, 470, 471, 476, 479, 480, 485, 493; ComSt 310, 311, 414, 493; Sp Cm 305, 321, 323, 327, 410, 412, and 493.

Communication Studies (ComSt)

(For those interested in the study of mass communication, see *Index, Journalism and Mass Communication*.)

Interpersonal and Rhetorical Communication (Sp Cm)

Courses Primarily for Undergraduate Students

Sp Cm 110. Listening. (3-0) Cr. 3. F.S.SS. Theory, principles, and competency development in comprehensive, therapeutic, critical, consumer, and appreciative listening. The impact of listening in relationships and partnerships.

Sp Cm 171. Improving Speech Effectiveness. (Same as CmDis 171.) See *Communication Disorders*.

Sp Cm 212. Fundamentals of Public Speaking. (3-0) Cr. 3. F.S.SS. Theory and practice of basic speech communication principles applied to public speaking. Practice in the preparation and delivery of extemporaneous speeches.

Sp Cm 223. Intercollegiate Debate and Forensics. Cr. 1 each time taken, maximum of 6 credits. F.S. *Prereq: Permission of instructor.* Participation in intramural and intercollegiate debate and other forensic events.

Sp Cm 290. Special Projects. Cr. 1 to 2 each time taken, maximum of 4 credits. F.S.SS. *Prereq: 3 credits in speech communication; permission of department chair.*

Sp Cm 298. Cooperative Education. Cr. R. F.S.SS. *Prereq: sophomore classification.* Required of all cooperative education students. Students must register for the course prior to commencing each work period.

Sp Cm 305. Semantics. (3-0) Cr. 3. F.S.SS. *Prereq: Engl 105.* The study of symbolic processes and how meaning is encoded in words, phrases, sentences, and utterances; discussion of modern theories of meaning; and an exploration of relationships among language, thought and action. Nonmajor graduate credit.

Sp Cm 312. Business and Professional Speaking. (3-0) Cr. 3. F.S.SS. *Prereq: 212.* Theory, principles, and competency development in the creation of coherent, articulate business and professional oral presentations.

Sp Cm 313. Communication for the Classroom Teacher. (3-0) Cr. 3. S.SS. *Prereq: 212.* Communication in the teaching profession; training in classroom-oriented communication activities; use of video recorder for analysis of presentation.

Sp Cm 321. Communication with the Elderly. (Same as Geron 321.) (3-0) Cr. 3. S. Communication theory and practice presented with applications and strategies for interactions with elderly persons. Interpersonal competencies in social conversations

and interviewing developed. Nonmajor graduate credit.

Sp Cm 322. Argumentation, Debate, and Critical Thinking. (3-0) Cr. 3. F.SS. *Prereq: 212.* Practice in preparing and presenting argumentative and debate speeches; emphasis on critical thinking and ethical and logical duties of the advocate; analysis, evidence, reasoning, attack, defense, research, case construction, and judging.

Sp Cm 323. Gender and Communication. (Same as W S 323.) (3-0) Cr. 3. F. *Prereq: 212.* The rhetorical strategies women and men use to succeed in oral communication; the theory, principles, and practice of effective gender communication in a variety of settings. Nonmajor graduate credit.

Sp Cm 324. Legal Communication. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: 212.* Speech communication in the legal system inside and outside the trial process: interviewing and counseling, negotiating and bargaining, *voir dire*, opening statements, examination of witnesses, closing arguments, judge's instructions, jury behavior, and appellate advocacy.

Sp Cm 325. Nonverbal Communication. (Same as ComSt 325.) See *Communication Studies*.

Sp Cm 327. Persuasion. (3-0) Cr. 3. F.S.SS. *Prereq: 212.* Examination of persuasive theories, strategies and research in persuasion. Emphasis on application and analysis; logical, emotional, and ethical proofs. Nonmajor graduate credit.

Sp Cm 398. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of departmental cooperative education coordinator; 398: junior or senior classification.* Required of all cooperative education students. Students must register for the course prior to commencing each work period.

Sp Cm 404. Seminar. (Dual-listed with 504.) Cr. 3 each time taken, maximum of 9. *Prereq: 18 credits in speech communication.*
A. Interpersonal and Rhetorical Communication.
B. Speech Education.

Sp Cm 410. Classical Rhetoric. (3-0) Cr. 3. S. *Prereq: 12 hours in speech communication.* Greek and Roman tradition in rhetorical theory, practice, criticism, and pedagogy. Nonmajor graduate credit.

Sp Cm 412. Rhetorical Criticism. (3-0) Cr. 3. S. *Prereq: 212 and 6 credits in speech communication.* Development of rhetorical theory and practice from Corax to modern times. Application of principles of criticism to current public speaking practices. Nonmajor graduate credit.

Sp Cm 416. American Public Address. (3-0) Cr. 3. S. Relationship between public persuasions and leaders; process of preparing major public addresses; selected speakers and speeches as linked with political or historical events.

Sp Cm 417. Campaign Rhetoric. (Same as Pol S 417.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: 212.* Backgrounds of candidates for state and national elections; selected speeches and issues; persuasive strategies and techniques of individual speakers.

Sp Cm 490. Independent Study. Cr. 1 to 3 each time taken, maximum of 9. F.S.SS. *Prereq: 18 credits in speech communication, junior classification, permission of department chair.* Only one independent study enrollment is permitted within the department per semester.

Sp Cm 493. Workshop. Cr. var. 1 to 3 each time offered. F.S.SS. *Prereq: 12 credits in speech communication courses.* Offered irregularly to explore special topics not adequately covered in other course offerings. Materials fee. Nonmajor graduate credit.

Sp Cm 495A. Directing Speech Activities. (1-0) Cr. 1. S. *Prereq: C I 301; 9 credits in speech communication; minimum grade point of 2.5 in speech communication courses.* Problems, methods, and materials related to directing speech activities in secondary schools.

Sp Cm 495B. Teaching Speech. (Same as C I 495B.) (3-0) Cr. 3. F. *Prereq: Sp Cm 313; 9 credits in speech*

communication; minimum grade point average of 2.5 in speech communication courses. Problems, methods, and materials related to teaching speech, theatre, and media in secondary schools.

Sp Cm 497. Senior Seminar. (3-0) Cr. 3. S. Prereq: 15 credits in speech communication; senior classification. Students synthesize relevant theory and research culminating in a senior project/paper.

Sp Cm 499. Communication Internship. Cr. var. 1 to 3, each time taken, maximum of 6. F.S.SS. Prereq: 18 credits in speech communication courses, other courses deemed appropriate by faculty adviser; 2nd semester junior or senior standing; cumulative GPA of at least 2.5 overall and 3.0 in speech communication; and permission of the internship committee. Applications should be submitted in the term prior to the term in which the internship is desired. Supervised application of interpersonal and rhetorical communication in professional settings.

Courses Primarily for Graduate Students, open to qualified undergraduates

Sp Cm 504. Seminar. (Dual-listed with 404.) Cr. 3 each time taken, maximum of 9. F.S.SS. Prereq: 9 credits in speech communication. Topics may include the following:

- A. Interpersonal and Rhetorical Communication
- B. Speech Education

Sp Cm 513. Proseminar: Teaching Fundamentals of Public Speaking. (0-2) Cr. 1. F. Required of all new Speech Communication 212 teaching assistants. Introduction to the teaching of public speaking. Support and supervision of teaching assistants of Sp Cm 212. Discussion of lesson planning, teaching methods, development of speaking assignments, and evaluation of student speaking.

Sp Cm 590. Special Topics. Cr. 1 to 4 each time taken, maximum of 12 credits. Prereq: Permission of department chair.

Statistics

Dean L. Isaacson, Head of Department

Distinguished Professors: Athreya, Fuller, Meeker

University Professors: Groeneveld

Professors: Amemiya, Bailey, Bonett, Isaacson, Kennedy, Koehler, Lahiri, Lorenz, Morris, Pollak, Shelley, Stephenson, Stern, Stufken, Vardeman

Distinguished Professors (Emeritus): H. A. David, Kempthorne

University Professors (Emeritus): D. Cox, H.T. David, Hinz

Professors (Emeritus): C. Cox, Harville, Hickman, Hotchkiss, Huntsberger, Strahan, Wolins

Associate Professors: Breidt, Carriquiry, Cook, Dixon, Kaiser, Marasinghe, Nusser, Roberts, Rollins, Sherman, Sukhatme

Assistant Professors: Biliias, Daniels, Duckworth, Opsomer, Wu, Yang

Undergraduate Study

For the undergraduate curriculum in liberal arts and sciences, major in statistics, leading to the degree bachelor of science, see *Liberal Arts and Sciences, Curriculum*.

The curriculum in liberal arts and sciences with a major in statistics is designed to prepare students for (1) entry level statistics positions requiring the B.S. degree in statistics in busi-

ness or commerce, nonprofit institutions, and in state or federal government; (2) graduate study in statistics. Entry-level positions include the following types of work: statistical design, analysis and interpretation of experiments and surveys; data processing and analysis using modern computation facilities and statistical computing systems; application of statistical principles and methods in commercial areas such as finance, insurance, industrial research, marketing, manufacturing, and quality control. Nonprofit organizations such as large health study institutions have entry-level positions for B.S. graduates in statistics. Also, there are opportunities for work in statistics that require a major in a subject-matter field and a minor in statistics.

Students completing the undergraduate degree in statistics should have a broad understanding of the discipline of statistics. They should have a clear comprehension of the theoretical basis of statistical reasoning and should be proficient in the use of modern statistical methods and computing. Such graduates should have an ability to apply and convey statistical concepts and knowledge in oral and written form. They should be aware of ethical issues associated with polling and surveys and in the summarization of the outcomes of statistical studies.

Undergraduate majors in this department usually include in their programs: (a) Statistics 101 or an alternative introductory course (104 or 227), (b) Mathematics 165, 166, 265 (or 165H, 166H, 265H), 307 (or 317) and Computer Science 103, and (c) Statistics 341, 342, 401, 402, 421, 479, 480.

These courses plus at least two additional courses in statistics at the 400 level or above constitute the major. With the permission of the department, I E/Stat 361 may be substituted for one of these 400 level courses. It is advisable to have a minor in a field of application.

The department offers a minor in statistics which may be earned by completing one of three options. Option I: one of 101, 104 or 105; 231 or 401. Option II: 341, 342; 231 or 401. Option III: 227, 328. Additional courses in statistics at the 300 level or above are required for each option to yield a total of at least 15 credits in statistics courses.

English and Speech proficiency requirement: The department requires a grade of C- or better in each of Engl 104 and 105 (or 105H), and completion of one of Engl 302 or 314 with a grade of C- or better. The department requires a passing grade in ComSt 102 or Sp Cm 212.

Students intending to do graduate work in statistics normally will take additional courses in mathematics.

Graduate Study

The department offers the degrees master of science and doctor of philosophy with a major in statistics, and minor work for students majoring in other departments. Within the statistics major the student may select areas of specialization in experimental design, probability, statistical methods, statistical theory, statis-

tical computing, survey sampling, quality control, spatial statistics, time series, reliability, or applied statistics (e.g., biometrics, econometrics, environmental statistics, psychometrics, sociometrics, etc.). A major in operations research leading to a master of science degree is offered in cooperation with the Department of Industrial and Manufacturing Systems Engineering. The doctor of philosophy degree is offered as a co-major with other departments. Such departments have included Animal Science, Botany, Economics, Educational Leadership and Policy Studies, Genetics, Industrial and Manufacturing Systems Engineering, Mathematics, Meteorology, and Psychology.

M.S. graduates have a basic understanding of statistical theory and methods. Elective courses in statistics provide areas of specialization based on the student's career goals. Communication skills are developed through course projects, assistantship duties and creative components. Ph.D. graduates study advanced theory and methods and are able to do independent research in statistics and collaborative research outside of statistics.

Prerequisite to major graduate work is the completion of an undergraduate curriculum essentially equivalent to the curriculum in liberal arts and sciences at this institution including at least a year of calculus.

The degree master of science may be earned on either a thesis or nonthesis basis. The nonthesis option requires the completion of at least 34 credits of acceptable graduate work, including the completion of a creative component and satisfactory performance on a written examination.

The department encourages students to prepare themselves in foreign languages and in computer languages, but specific requirements for the degrees master of science and doctor of philosophy are at the discretion of the student's advisory committee.

The department participates in the interdisciplinary program in business administrative sciences and in the interdepartmental major in genetics.

Courses open for nonmajor graduate credit: 328, 333, 361, 401, 402, 403, 404, 407, 421, 432, 436, 447, 451, 479, 480, 493, 495, 496.

Courses Primarily for Undergraduate Students

Stat 100. Orientation in Statistics. (1-0) Cr. R. F. Opportunities, challenges, and the scope of the curriculum in statistics. For students planning or considering a career in this area.

Stat 101. Principles of Statistics. (3-2) Cr. 4. F.S.SS. Prereq: 1 1/2 years of high school algebra. Statistical concepts in modern society; descriptive statistics and graphical displays of data; the normal distribution; data collection; elementary probability; elements of statistical inference; estimation and hypothesis testing; linear regression and correlation; contingency tables. Credit for only one of the following courses may be applied toward graduation: 101, 104, 105, 227.

Stat 104. Introduction to Statistics. (2-2) Cr. 3. F.S.SS. Prereq: 1 1/2 years of high school algebra. Statistical concepts and their use in science; collecting, organizing and drawing conclusions from data; sampling and experimentation as ways of generating data; methods for describing and summarizing data

and understanding relationships; statistical inference. For students in the agricultural and biological sciences. Credit for only one of the following courses may be applied toward graduation: 101, 104, 105, 227.

Stat 105. Introduction to Statistics for Engineers. (3-0) Cr. 3. F.S. *Prereq:* *Math 165 (or 165H)*. Statistical concepts with emphasis on engineering applications. Data collection; descriptive statistics; probability distributions and their properties; elements of statistical inference; regression; statistical quality control charts; use of statistical software; team project involving data collection, description and analysis. Credit for only one of the following courses may be applied toward graduation: 101, 104, 105, 227. Credit for both 105 and 305 may not be applied for graduation.

Stat 201. Applied Regression Analysis for Business. (2-0) Cr. 2. F. *Prereq:* *101 or 104 or 105*. Brief review of required descriptive and inferential statistics; statistical process monitoring and applications in quality control; use of computers to analyze data; simple linear regression analysis; multiple regression analysis; diagnostic checking and model building; application of regression techniques to analysis of variance and time series analysis. Credit for both 201 and 227 may not be applied toward graduation.

Stat 227. Introduction to Business Statistics. (4-2) Cr. 5. F.S.SS. *Prereq:* *Math 150 or 165*. Obtaining, presenting, and organizing statistical data; measures of location and dispersion; probability concepts; the normal distribution; sampling and sampling distributions; estimation and confidence intervals; statistical process monitoring and applications in quality control; use of computers to analyze data; simple linear regression analysis; multiple regression analysis. Credit for only one of the following courses may be applied toward graduation: 101, 104, 105, 227. Credit for both 201 and 227 may not be applied toward graduation.

Stat 231. Probability and Statistical Inference for Engineers. (4-0) Cr. 4. F.S. *Prereq:* *Credit or enrollment in Math 265*. Emphasis on engineering applications. Basic probability; random variables and probability distributions; joint and sampling distributions; propagation of error. Descriptive statistics; confidence intervals; hypothesis testing; simple linear regression; multiple linear regression; one way analysis of variance; use of statistical software.

Stat 305. Engineering Statistics. (3-0) Cr. 3. F.S. *Prereq:* *Math 165 (or 165H)*. Statistics for engineering problem solving with emphasis on the design and analysis of experiments. Descriptive statistics; elementary probability distributions; principles of experimentation; confidence intervals and significance tests; one-, two-, and many-factor studies; regression analysis; use of statistical software; team project involving multi-factor experimentation and analysis. Credit for both 105 and 305 may not be applied for graduation.

Stat 328. Applied Business Statistics. (2-2) Cr. 3. F.S. *Prereq:* *201 or 227*. Application of statistical methods to problems in business and economics; review of multiple regression; residual analysis; model building; analysis of variance; introduction to experimental design concepts; time series analysis and forecasting. Nonmajor graduate credit.

Stat 333. Probability and Statistics for Electrical and Computer Engineers. (3-0) Cr. 3. F.S. *Prereq:* *Math 267*. Accelerated and rigorous introduction to probability and statistics. Applications to areas of electrical and computer engineering such as systems, control, signal processing, digital and analog circuits, communications. Discrete and continuous random variables, associated probability models, extensions to random vectors and random processes. Applications to parameter estimation, confidence intervals, hypothesis testing, regression, time series, spectral estimation. Nonmajor graduate credit.

Stat 341. Introduction to the Theory of Probability and Statistics. (Same as Math 341.) (3-0) Cr. 3. F.S. *Prereq:* *Math 265 (or 265H)*. Probability; distribution functions and their properties; classical discrete and continuous distributions; moment generating func-

tions. Credit for both 341 and 447 may not be applied toward graduation.

Stat 342. Introduction to the Theory of Probability and Statistics. (Same as Math 342.) (3-0) Cr. 3. S. *Prereq:* *341, Math 307 or 317*. Theory of estimation and tests of hypotheses; regression and correlation; linear model theory; enumerative data.

Stat 361. Quality Control. (Same as I E 361.) See *Industrial Engineering*. Nonmajor graduate credit.

Stat 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of department head*. Off-campus work periods for undergraduate students in a field of statistics.

Stat 401. Statistical Methods for Research Workers. (3-2) Cr. 4. F.S.SS. *Prereq:* *101 or 104 or 105 or 201 or 227*. Graduate students without an equivalent course should contact the department. Methods of analyzing and interpreting experimental and survey data. Statistical concepts and models; estimation; hypothesis tests with continuous and discrete data; simple and multiple linear regression and correlation; introduction to analysis of variance. Nonmajor graduate credit.

Stat 402. Statistical Design and the Analysis of Experiments. (3-0) Cr. 3. F.S. *Prereq:* *401*. The role of statistics in research and the principles of experimental design. Experimental units, randomization, replication, blocking, subdividing and repeatedly measuring experimental units; factorial treatment designs and confounding; extensions of the analysis of variance to cover general crossed and nested classifications and models that include both classificatory and continuous factors. Nonmajor graduate credit.

Stat 403. Nonparametric Statistical Methods. (2-0) Cr. 2. Alt. F., offered 2000. *Prereq:* *231 or 328 or 401*. Groeneveld. Analysis of data when the dependent variable has ordinal or nominal properties; statistical inference for ranked data; Mann-Whitney and Kruskal-Wallis procedures; rank correlation; efficiency of nonparametric procedures and robustness of comparable parametric procedures. Nonmajor graduate credit.

Stat 404. Statistics for the Social Sciences. (2-2) Cr. 3. F. *Prereq:* *401*. Lorenz, Roberts. Applications of generalized linear regression models to social science data. Assumptions of regression; diagnostics and transformations; analysis of variance and covariance; path analysis. Nonmajor graduate credit.

Stat 407. Methods of Multivariate Analysis. (2-2) Cr. 3. F. *Prereq:* *401, knowledge of matrix algebra*. Techniques of analyzing multivariate data including comparing means using Hotelling's T^2 , multivariate analysis of variance, reducing variable dimension with principal components, grouping/classifying observations with cluster analysis and discriminant analysis. Nonmajor graduate credit.

Stat 421. Survey Sampling Techniques. (2-2) Cr. 3. S. *Prereq:* *231 or 328 or 401*. Methods of designing and analyzing survey investigations; simple random, stratified, and multistage sampling designs; methods of estimation including ratio and regression; construction and use of sample frames. Nonmajor graduate credit.

Stat 432. Applied Probability Models. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* *231 or 341 or 447*. Groeneveld. Probabilistic models in engineering and the physical sciences; probability; Markov chains; Poisson and renewal processes; applications to queuing, scheduling, control, and other quantitative problems. Nonmajor graduate credit.

Stat 436. Quantitative Genetics. (3-0) Cr. 3. S. *Prereq:* *401*. Bailey. Description of the theory of basic genetic models of quantitative traits. Identification and discussion of information required for the application of Quantitative Genetics (QG) theory. Design and analysis of statistical experiments in QG. Genetic and statistical implications of natural and artificial selection, including marker assisted selection, as the basis of genetic improvement. Nonmajor graduate credit.

Stat 447. Statistical Theory for Research Workers. (4-0) Cr. 4. F.S. *Prereq:* *Math 151 and permission of instructor, or Math 265*. Amemiya, Yang. Primarily for graduate students not majoring in statistics. Emphasis on aspects of the theory underlying statisti-

cal methods. Probability, population distributions and their properties, sampling distributions, point and interval estimation, tests of hypotheses, simple regression. Credit for both 341 and 447 may not be applied toward graduation. Nonmajor graduate credit

Stat 451. Applied Time Series. (3-0) Cr. 3. S. *Prereq:* *231 or 328 or 401*. Meeker. Methods for analyzing data collected over time; review of multiple regression analysis. Elementary forecasting methods: moving averages and exponential smoothing. Autoregressive-moving average (Box-Jenkins) models: identification, estimation, diagnostic checking, and forecasting. Transfer function models and intervention analysis. Nonmajor graduate credit.

Stat 479. Computer Processing of Statistical Data. (3-0) Cr. 3. F. *Prereq:* *401, Marasinghe*. Structure, content and programming aspects of a modern statistical package. Advanced techniques in the use of a statistical software system for data analysis. Introduction to graphical methods in statistics and a matrix programming language. Nonmajor graduate credit.

Stat 480. Statistical Applications of Digital Computers. (3-0) Cr. 3. S. *Prereq:* *231 or 328 or 401, Com S 103*. Modern statistical computing. Data management; spread sheets, verifying data accuracy, transferring data between systems. Data and graphical analysis with microcomputer statistical software packages. Macro programming. Simulation. Interface with the World Wide Web. Nonmajor graduate credit.

Stat 490. Independent Study. Cr. var. *Prereq:* *10 credits in statistics*. No more than 9 credits in Stat 490 may be counted toward graduation. H: Honors.

Stat 493. Workshop in Statistics. (1-0 or 2-0) Cr. 1 or 2. Off-campus, offered as demand warrants. *Prereq:* *101 or 104 or 227*. Planning, executing, and interpreting experiments by understanding experimental design and utilizing the statistical concepts of linear models. Designed for master of agriculture program only. Nonmajor graduate credit.

Stat 495. Applied Statistics for Industry. (3-0) Cr. 3. F. *Prereq:* *101 or 104 or 105 or 201 or 227; Math 166 (or 166H)*. Graduate students without an equivalent course should consult the department. Statistical thinking applied to industrial processes. Assessing, monitoring and improving processes using statistical methods. Analytic/enumerative studies; graphical displays of data; process monitoring; control charts; capability analysis. Nonmajor graduate credit.

Stat 496. Applied Statistics for Industry. (3-0) Cr. 3. S. *Prereq:* *495*. Statistical design and analysis of industrial experiments. Concepts of control, randomization and replication. Simple and multiple regression; factorial and fractional factorial experiments; reliability; analysis of lifetime data. Nonmajor graduate credit.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Stat 500. Statistical Methods. (3-2) Cr. 4. F. *Prereq:* *101*. Introduction to methods for analyzing data from experiments and surveys. Graphical data summaries. Comparison of groups using t-tests, analysis of variance, and nonparametric analogs. Uses of randomization, blocking, factorial designs, and nested units in experiments. Correlation and regression models, model selection and assessment, effects of collinearity. Introduction to SAS statistical software.

Stat 501. Multivariate Statistical Methods. (3-0) Cr. 3. S. *Prereq:* *500 or 402; 447 or 542; knowledge of matrix algebra*. Statistical methods for analyzing and displaying multivariate data: dynamic graphics, principal components, factor analysis, canonical correlations, cluster analysis, classification methods, Hotelling's T^2 , multivariate analysis of variance. Statistical software: SAS, S-Plus, and XGOBI.

Stat 505. Environmental Statistics. (2-2) Cr. 3. Alt. S., offered 2000. *Prereq:* *341 or 447; 401*. Basic ideas of statistical modeling for environmental applications; causation versus association; ecotoxicology; limits of detection; spatial statistics; geostatistics, kriging, spatial sampling; hierarchical modeling, Bayesian methodology.

Stat 511. Statistical Methods. (3-0) Cr. 3. S. *Prereq:* 500 or 402 or 404; 447 or 542 and current enrollment in 543; *knowledge of matrix algebra.* Introduction to the general theory of linear models, projections and distributions of quadratic forms; Linear models with both fixed and random factors, variance components, dealing with missing data and unbalanced designs. Introduction to non-linear and generalized linear models, maximum likelihood estimation, local smoothing methods; Bootstrap and other sample reuse procedures. Introduction to hierarchical models and Bayesian inference. Requires use of SAS and S-Plus statistical software.

Stat 512. Design of Experiments. (3-0) Cr. 3. F. *Prereq:* 511. Stufken. Basic ideas of experimental design with applications: completely randomized, randomized block, and Latin Square designs; randomization analysis; factorial experiments, confounding, fractional replication; split-plot and incomplete block designs; crossover designs.

Stat 513. Response Surface Methodology. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 402 or 512, *knowledge of elementary matrix theory.* Morris. Design criteria and optimality; determination of optimum operating conditions; exploration of response surfaces; robust estimation and transformations; mixture experiments; construction of optimal designs. Optimization for multiple-response problems.

Stat 514. Scheduling and Inventory Theory. (Same as I E 514.) See *Industrial Engineering.*

Stat 515. Theory and Applications of Nonlinear Models. (3-0) Cr. 3. F. *Prereq:* 447 or 543, 511. Kaiser. Construction of nonlinear statistical models; random and systematic model components, review of likelihood-based inferences. Iterative algorithms for maximum likelihood estimation. Nonlinear regression models using additive error with nonconstant variance, transform both sides models, generalized linear models and their extensions. Introduction to compartment models, growth curves and pharmacokinetic models. Basic random parameter models, beta-binomial and gamma-Poisson mixtures. Requires use of instructor-supplied and student-written S-plus functions.

Stat 521. Theory and Applications of Sample Surveys. (3-0) Cr. 3. S. *Prereq:* 401; 447 or 542. Breidt, Opsomer. Practical aspects and basic theory of design and estimation in sample surveys for finite populations, with emphasis on applications. Simple random, systematic, stratified, cluster and multistage sampling. General unequal probability designs. Horvitz-Thompson estimation of totals and functions of totals: means, proportions, covariances, regression coefficients. Model-assisted ratio and regression estimation. Two-phase sampling. Variance estimation for complex designs. Nonsampling errors.

Stat 531. Quality Control and Engineering Statistics. (Same as I E 531.) (3-0) Cr. 3., Alt. S., offered 2001. *Prereq:* 401; 342 or 447. Vardeman. Statistical methods and theory applicable to problems of industrial process monitoring and improvement. Statistical issues in industrial measurement; Shewhart, CUSUM, and other control charts; feedback control; process capability studies; estimation of product and process characteristics; acceptance sampling, continuous sampling and sequential sampling; economic and decision theoretic arguments in industrial statistics; experimentation for process improvement.

Stat 533. Reliability. (Same as I E 533.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 342 or 432 or 447. Meeker. Probabilistic modeling and inference in reliability; analysis of systems; Bayesian aspects; product limit estimator, probability plotting, maximum likelihood estimation for censored data, accelerated failure time and proportional hazards regression models with applications to accelerated life testing; repairable system data; planning studies to obtain reliability data.

Stat 534. Ecological Statistics. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 447 or 542. Statistical methods for analysis of data from ecological field studies. Sampling strategies for estimation of diversity and species richness. Comparison of ecological quantities among regions and across time. Statistical formulation of ecological concepts such as competition and

biodiversity. Effects of time and space on population dynamics models. Ordination and analysis of complex multivariate data. Statistical methods discussed will include randomization and permutation tests, spatial point processes, bootstrap estimation of standard error, changepoint regression models, random parameter models and Empirical Bayes methods.

Stat 535. Methods in Biostatistics. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 500; 543 or 447. Daniels. Statistical methods useful for biostatistical problems. Topics include analysis of observational studies and randomized clinical trials, techniques in the analysis of survival and longitudinal data, approaches to handling missing data, and meta-analysis. Examples will come from recent studies in cancer, AIDS, heart disease and psychiatry and from studies to evaluate health care in the U.S. (health services research).

Stat 536. Genetic Statistics. (Same as Gen 536.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 401, 447; *Gen 320 or Biol 301 or permission of instructor.* Pollak. Probability applied to genetic systems; random mating; selection, mutation and migration; theory of inbreeding; effects of finite population size; basic concepts in quantitative genetics; prediction of progress from artificial selection.

Stat 537. Genetic Statistics. (Same as Gen 537.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 536 or *permission of instructor.* Sampling designs and experimental designs to obtain information from markers; detecting major genes; linkage analysis and segregation analysis; finding alignments and similarities between DNA sequences; constructing phylogenetic trees.

Stat 538. Econometric Statistics. (Same as Econ 538.) (3-0) Cr. 3. F. *Prereq:* 542 or *Econ 573.* Billias. Generalized linear regression, nonlinear regression, measurement error models. Simultaneous equation systems, regression equations with autoregressive errors, large sample theory.

Stat 539. Game Theory. (Same as Econ 539, I E 539.) (3-0) Cr. 3. F. *Prereq:* 341 or 432 or 447. Zero-sum and bi-matrix non-cooperative two person games; games of timing; relation to mathematical programming; cooperative n-person games.

Stat 542. Theory of Probability and Statistics. (4-0) Cr. 4. F. *Prereq:* 341; *Math 414 or 465.* Sample spaces, probability, conditional probability; Random variables, expectation, inequalities; Common theoretical distributions; Joint distributions, conditional distributions, introduction to Bayesian inference; Introduction to point estimation including maximum likelihood estimation, method of moments, basic properties of point estimators; Stochastic processes with applications to Poisson Process, Brownian motion; Moment generating functions and characteristic functions; Probability laws of transformations, sampling distributions, order statistics.

Stat 543. Theory of Probability and Statistics. (3-0) Cr. 3. S. *Prereq:* 542. Point estimation including maximum likelihood estimation, Bayes estimators, Bayesian and minimax optimality, unbiasedness, sufficiency, completeness, Basu's theorem; Convergence in probability, convergence in distribution, laws of large numbers, central limit theorem; Confidence intervals, prediction intervals; Hypothesis testing, Neyman-Pearson Lemma, uniformly most powerful tests, likelihood ratio tests; Bayesian interval estimation and tests; Nonparametric methods, bootstrap.

Stat 544. Bayesian Statistics. (3-0) Cr. 3. S. *Prereq:* 543. Stern. Specification of probability models; subjective, conjugate, and noninformative distributions; hierarchical models; analytical and computational techniques for obtaining posterior distributions; model checking, model selection, diagnostics; comparison of Bayesian and traditional methods; empirical Bayes procedures; decision theory.

Stat 546. Theory of Nonparametric and Asymptotic Methods. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 542. Sukhatme. Introduction to nonparametric problems; tests based upon sample distribution functions, rank tests for location, scale and independence; local properties of rank tests; convergence of a sequence of random variables; limit theorems; asymptotic distributions of sample quantiles,

U-statistics, rank statistics, chi-square and other goodness of fit test statistics; asymptotic efficiency of tests.

Stat 551. Time Series Analysis. (3-0) Cr. 3. F. *Prereq:* 447 or 542. Stationary and non-stationary time series; covariance and spectral properties of stationary time series; autoregressive moving average processes; best linear prediction; state space models and Kalman recursions; estimation techniques, model-building and diagnostics.

Stat 554. Introduction to Stochastic Processes. (Same as Math 554.) See *Mathematics.*

Stat 555. Theory of Stochastic Processes. (Same as Math 555.) See *Mathematics.*

Stat 557. Statistical Methods for Counts and Proportions. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 500 or 401; 543 or 447. Koehler. Statistical methods for analyzing simple random samples when outcomes are counts or proportions; measures of association and relative risk, chi-squared tests, loglinear models, logistic regression and other generalized linear models, extensions to longitudinal studies and nested designs. Maximum likelihood estimation, generalized estimating equations. Use of statistical software: SAS and S-Plus.

Stat 579. Orientation to Software Systems for Statistical Computing. (1-0) Cr. 1. F. *Prereq:* *Graduate classification in statistics.* Kennedy, Marasinghe. Orientation to scientific and statistical software available on campus. Offered on a satisfactory-fail grading basis only.

Stat 580. Computational Methods in Statistics. (3-0) Cr. 3. S. *Prereq:* 500, 542. Marasinghe. Linear and nonlinear least squares and regression computations, computations associated with maximum likelihood estimation problems, applications of Monte Carlo methods in statistics research, computer intensive applications including the bootstrap, evaluation of multiple integrals, EM algorithm, etc. Assignments will include applications of these methods using the S-Plus programming language.

Stat 581. Advanced Statistical Computing. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 511, 580 and *programming in a scientific language.* Marasinghe, Kennedy. Numerical computations and algorithms with applications in statistics. These include discussions on random number generation, solution of nonlinear equations, optimization methods, matrix linear algebra and numerical integration.

Stat 590. Special Topics. Cr. var.
A. Theory
B. Methods
C. Design of Experiments
D. Design of Surveys

Stat 599. Creative Component.

Courses for Graduate Students

Stat 601. Advanced Statistical Methods. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 511; *Math 514.* Kaiser. This course is designed to provide students with in-depth coverage of topics from current and recent developments in statistical modeling and applications. Recent topics have included Markov Chain Monte Carlo methods for Bayesian analysis of hierarchical models, conditionally specified statistical models, complex random parameter models, and Bayesian dynamic models. Applications have included problems of monitoring air and water quality, spatial modeling of organism abundance and disease rates, and population pharmacokinetic models. Requires some programming ability to deal with computationally intensive methods.

Stat 606. Spatial Statistics. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 511, 543. General spatial models; spatial data analysis; continuous spatial variation, geostatistics, kriging; lattice data, conditional models, joint models; image analysis; point patterns, randomness, clustering, random sets.

Stat 611. Theory and Applications of Linear Models. (3-0) Cr. 3. F. *Prereq:* 500 or 402 or 404, 542 or 447, a course in matrix algebra. Stufken, Wu. Matrix preliminaries, estimability, theory of least squares and of best linear unbiased estimation, analy-

sis of variance and covariance, distribution of quadratic forms, extension of theory to mixed and random models, inference for variance components.

Stat 612. Advanced Design of Experiments. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 512. Stufken. Design optimality criteria and optimal designs; Galois fields and finite geometries with applications to design construction; fractional factorial designs; theory of approximate designs and the equivalence theorem; crossover designs with applications.

Stat 621. Advanced Theory of Survey Sampling. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 521. Breidt. Advanced topics of current interest in design of surveys and analysis of survey data; criteria for choice of survey strategies including sufficiency, likelihood, and admissibility; super population models and their role in choice of optimal strategies; review of recent literature.

Stat 642. Advanced Probability Theory. (3-0) Cr. 3. S. *Prereq:* 542, Math 514. Athreya, Lahiri. Probability spaces; Kolmogorov's existence theorem for stochastic processes; expectation; Jensen's inequality and applications; Borel-Cantelli lemmas; Weak and strong laws of large numbers; convergence of moments; weak convergence of probability distributions; characteristic functions; continuity theorem; Lindeberg-Feller central limit theorem and its ramifications; conditional expectation and probability; discrete time martingales, renewal theory and Markov chains, Brownian motion.

Stat 643. Theory of Estimation and Testing of Hypotheses. (3-0) Cr. 3. F. *Prereq:* 543, 642. Lahiri, Vardeman. Sufficiency completeness; Elements of decision theory; Bayesian paradigm of inference and theory of Markov Chain Monte Carlo; Invariance; Neyman-Pearson theory of testing hypotheses. Uniformly most powerful tests, introduction to unbiased tests, likelihood ratio tests, Wald's tests, Rao's tests; Asymptotic theory of maximum likelihood estimation and likelihood ratio tests; Asymptotic efficiency; Resampling methods.

Stat 645. Order Statistics. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 543. Distribution theory and moments of order statistics; estimation of location and scale parameters; censoring; robust estimation; treatment of outliers; asymptotic distributions of quantiles, extremes, and linear functions of order statistics.

Stat 647. Multivariate Analysis. (3-0) Cr. 3. F. *Prereq:* 543, knowledge of matrix algebra. Amemiya. Multivariate normal distribution, Wishart distribution, multiple, partial, and canonical correlations, inference for mean vector, multivariate regression, principal components, discriminant analysis, factor analysis, covariance structure analysis, latent variable modeling.

Stat 648. Seminar on Theory of Statistics and Probability. Cr. var. Alt. S., offered 2000. *Prereq:* 643.

Stat 651. Time Series. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 551, 642. Fuller. Covariance and spectral representation of time series. Stationary and non-stationary autoregressive models. Fourier and periodogram analyses. Stochastic difference equations. Estimation and distribution theory.

Stat 680. Advanced Statistical Computing. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 580. Cook, Kennedy. Selected methods and algorithms in selected areas of statistical computing. Emphasis on the most recent advances in these and other areas supported by statistical computing.

Stat 690. Advanced Special Topics. Cr. Var. *Prereq:* Permission of instructor.
A. Theory
B. Methods
C. Design of Experiments
D. Design of Surveys
E. Statistical Computing
F. Graphics

Stat 699. Research.

Systems Engineering

(Interdepartmental Graduate Major)

Supervisory Committee: D. Gemmill (Chair), Flugrad, E. Jones, J. Vogel.

Work is offered for the master of engineering with a major in systems engineering. The graduate major in Systems Engineering is both an on- and off-campus program. It is an interdisciplinary program that allows students to take courses across a variety of departments. Graduates of the program will possess the analytical abilities needed to design, evaluate, and build complex systems involving many components and demanding specifications. They will have the ability to work across disciplinary boundaries, as the practice of modern engineering often requires. Graduates will have developed management capabilities and extended their disciplinary knowledge.

The program is broadly based and uses courses in the various departments of the College of Engineering and courses in other departments of the university. The 30 credits necessary for graduation includes 27 semester credits of formal coursework and 3 credits for a creative component. Completion of the program requires two courses in systems engineering, two courses in the major discipline of the student, three engineering courses with a systems engineering emphasis, two courses outside of the college, and a creative component. Courses are delivered to off-campus students both with the instructor present and through various distance education systems, including the Iowa Communications Network (ICN), satellite transmission, and videotape.

The program of study committee, in consultation with the student, determines the courses to be taken and the acceptability of transfer credits. The major professor should be selected from the discipline where a concentration of coursework will be taken.

Admission to the program requires a baccalaureate degree in engineering and admission to the graduate college. Students with degrees in other areas will be considered on an individual basis. The degree awarded is a Master of Engineering in Systems Engineering.

For additional information students should contact the Chair of the Supervisory Committee, 205 Engineering Annex, ISU, Ames, Iowa 50011.

Teacher Education

Walter H. Gmelch, Director, Teacher Education and Dean, College of Education

All students who are recommended by Iowa State University for teacher licensure must meet the requirements of the teacher education program and be recommended by the College of Education. An undergraduate seeking a bachelor's degree must be enrolled in the

department in which he or she plans to major and must meet the graduation requirements of that department and the college in which it is located. Students already holding a bachelor's degree should consult with the coordinator of the area in which they plan to specialize so that an individualized program of study can be developed.

Admission to Undergraduate Teacher Education Program

A student seeking admission to a teacher education program must be accepted by a selection committee for the specific program which the student seeks to enter. Factors considered in evaluating applications include scholarship, interest in teaching, character, and physical and mental health. Recommendations by selection committees must be confirmed by the University Teacher Education Committee before admission to the program in teacher education is granted.

Students may apply as early as four semesters before the one in which they plan to enroll for student teaching; however, they must be fully admitted into the Teacher Education Program by mid-semester prior to their planned student teaching semester. A 2.5 grade-point average is required for full admission to the teacher education program and this minimum average must be maintained through graduation to be recommended for licensure. In addition, admission to the university teacher education program requires a minimum composite score of 19 on the ACT (910 composite on SAT I), or minimum scores on the reading, writing, and mathematics subtests of the PPST of 172, 172, and 170 respectively. (Details regarding the dates and fees for the tests are available in the Testing Office in the Student Counseling Services Office.)

Student Teaching

Student teaching is the culminating experience to the teacher preparation program at Iowa State University. To ensure that students are prepared for this experience, the following requirements must be met:

1. Full admission to the teacher education program by mid-point of the semester prior to the semester when student teaching is planned.
2. Completion of the student teaching application by the first week of fall semester for spring student teaching and the first week of spring semester for fall student teaching. Details regarding application are available in the Field Experiences Office, N005 Lagomarcino Hall.
3. A minimum ISU cumulative grade point average of 2.50 or higher at time of application for student teaching.
4. A passing grade must have been earned in all required professional education courses.

Teacher Licensure

The Iowa Provisional License may be recommended for those who hold the bachelor's degree from Iowa State and who have completed the following:

1. All requirements of an approved teacher

education program, including the human relations requirement of C I 406 and one additional course designated as appropriate for the human relations requirement.

2. A minimum of 42 semester hours in courses designed to serve the general needs of college students. This total will include Engl 104 and 105, one course appropriate for developing interpersonal or group presentation skills*, Psych 230 or HD FS 102, Lib 160, one course in each area of physical sciences, biological sciences and mathematics, and one course in American history or American government.

3. Additional requirements as designated by the State of Iowa that include, but are not limited to, a special education component and 50 hours of pre-student teaching field experience, 40 of which are to be taken after admission to the Teacher Education Program.

4. In addition, an ISU cumulative grade point average of 2.50 or higher must be maintained through graduation (or completion of the Teacher Education Program) to be recommended for licensure.

Note: Specific courses taken to be used for licensure may not be taken pass/not pass.

Complete details of the State of Iowa requirements for licensure are outlined in the University Teacher Education Handbook that may be purchased at the University Bookstore.

Approval for the early childhood education license requires successful completion of the licensure curriculum through either the Department of Curriculum and Instruction or the Department of Human Development and Family Studies.

Graduate programs are available for those who seek approval as elementary and secondary school principals, superintendents, counselors, instructional media specialists, or teachers in community colleges (applied science and technology, vocational-technical or arts and sciences). Students also may pursue a program for approval to teach in the area of special education.

Approval for the school psychologist license requires the successful completion of that graduate program in the Department of Psychology.

Information concerning licenses not described above, as well as more detailed requirements for any license, may be obtained from the Education Student Services Office in the College of Education.

The General Education Requirement

All prospective teachers are required to complete a program in general education which is integrated with their professional preparation and extends through the undergraduate curriculum.

The student is expected to complete studies in five groups in general education. Usually, courses relating to a given area may be found in several different departments. Credits listed are minimum requirements.

	Cr.	
9	I. Biological sciences, physical sciences, and mathematics (one course required in each area)	
9	II. Social sciences	
6	III. Humanities	
9	IV. Communication skills	
1	V. Health, dance, physical education, safety	
34		
8	Additional credits in above areas	
42	Total	

This total will include Engl 104 and 105, one course appropriate for developing interpersonal or group presentation skills*, Psych 230 or HD FS 102, and Lib 160, and one course in American history or government. Additional credits in general education may be required by departments preparing teachers.

The Professional Teacher Education Requirement

As part of a total educational program, the prospective teacher must complete certain studies related directly to the profession of teaching. All students in teacher education must take the following courses: (See college department for appropriate course)

	Cr.	
3	C I 201—Instructional Technology	
3	C I 204—Social Foundations of American Education	
3	C I 333—Educational Psychology	
2	C I 406—Multicultural Awareness and Non-sexism in the Classroom	
2-3	One additional course designated as appropriate for the human relations requirement. A list of approved courses is available from the College of Education Student Services Office in E105 Lagomarcino Hall.	
12-16	Student teaching (minimum—12 weeks)	

Additionally, all students must satisfactorily complete at least one credit of pre-student teaching laboratory experience. This requirement may be met through a pre-student teaching course (e.g. C I 280) or, in certain subject areas, a course designated to provide an equivalent experience.

Secondary education students must also complete the following courses:

R C I 415—Senior Seminar
3 or 4 C I 426—Principles of Secondary Education

Professional Courses in Areas of Specialization

AgEdS—AgEds 211, 310, 410, 411, 417

Biology—LAS 417D, 480D, 492

Chemistry—LAS 417B, 492

Earth Sciences—LAS 417J, 492

English—Engl 392, 494, LAS 417E, 480E

Family and Consumer Sciences Education, Home Economics Education option—FCEDS 206, 206L, 306, 318, 403, 413, 417A, 417B, 420

Foreign Languages—F Lng 487, LAS 417G

General Science—LAS 417B, 492

Health Education—H S 375, 417

Mathematics—LAS 417C, Math 497

Music—LAS 417K and/or 417L, Music 464 or 465, 466

Physical Education—Ex Sp 375, 417, 418, 475

Physical Sciences—LAS 417B, 492

Physics—LAS 417B, 492

History and Social Sciences—LAS 417A, 480A, 493

Speech Communication—LAS 417F, Sp Cm 495A, 495B

The Requirements for Areas of Specialization in Teacher Education

A teacher must also be competent in the area of a teaching specialization. For instance, certain competencies are required of those who would teach at the prekindergarten-kindergarten or the elementary level. Those preparing to teach at the secondary level must develop a depth of understanding in one or more subject matter areas.

For full-time teaching in secondary schools an approved subject matter concentration of at least 30 semester hours is required. Additional subject matter areas, usually consisting of 24 semester hours each, are possible but not required. Students interested in adding a second subject area should consult with the coordinator of the area.

The additional courses required by specific teaching areas are:

Agricultural Sciences and Agribusiness

See *Curriculum, Agricultural Education*.

Art

See *Curriculum, Art Education, Department of Art and Design, B.F.A.*

Biology

Coordinator: George Knaphus

Students seeking approval to teach biology must earn 13 credits in chemistry, 8 in physics, and at least 6 in mathematics, and take the following biological courses: Biol 201, 201L, 202, 202L, 301, 301L, 302, 303, 302L, and 312.

Bot 306
Micro 202
Zool 355

Seven additional credits at the 300 level or above in a basic biological science. A course emphasizing concepts in biotechnology is recommended, but not required.

Students who have begun their biological science program under earlier catalogs need to

see the science teaching adviser if they have questions.

Chemistry

Coordinator: Thomas Greenbowe

Students seeking approval to teach chemistry must earn credits in the following courses:

General chemistry 177, 177L, 178,

Analytical chemistry 210 or 211, 211L, 316, and 316L

Organic chemistry 331, 331L, 332, 332L

Inorganic chemistry 301

Physical chemistry 321, 321L, 322

Math 165, 166

Phys 221, 222 or 111, 112

Strongly recommended but not required: Biol 201, 201L.

Students with an endorsement in a natural science who seek approval to teach chemistry as an additional area must earn credits in the courses below (15 minimum credits):

Chem 177, 177L, 178, 178L, 211, 211L, 331, 331L, 332, 332L

or

Chem 163, 163L, 164, 164L, 211, 211L, 231, 231L

Students with no natural science endorsement who seek approval to teach chemistry as an additional area must complete one of the two sets of courses listed above plus sufficient additional courses to total 24 chemistry credits, chosen from:

Chem 316, 316L, 301, 321, 322, 321L

or

BBMB 301, 320, 311, 451

In addition, students are required to take the physical science teaching methods course LAS 492.

Coaching Interscholastic Athletics

Coordinator: Deborah Rhea

Students seeking approval for the Iowa State University endorsement to coach interscholastic athletics must:

a. Satisfy the professional teacher education requirements of the College of Education.

b. Satisfy the requirements of a teaching specialization area.

c. Earn credits in the following: Zool 155; EX SP 220, 258, 355 (Prereq: Phys 106 or 111) or 356 (Prereq: Zool 155), 315, 365, 455 or 456.

Curriculum and Instruction

Elementary Education. See *Curriculum, Curriculum and Instruction*.

Early Childhood Education. See *Curriculum, Curriculum and Instruction*.

Earth Sciences

Coordinator: Frederick DeLuca

Students seeking approval to teach earth sciences must earn credits in the following courses:

Geol 100, 100L, 102, 102L, 302, 305, 311, 356, 365, 368, 480

Mteor 206

Astro 120, 150

Chem 177, 177L, 178, 178L

Phys 111, 112; or 221, 222

Math 151 or 160 or 165

Com S 107

and one course in biology.

Students with an endorsement in a natural science who seek approval to teach earth sciences as an additional area must earn credits in the following courses:

Geol 100, 100L, 102

Mteor 206

Astro 120, 150

Courses 300 or above—3 credits

Students with no other natural science endorsement, but who seek endorsement in this area, must take the listed courses plus additional credits in this area to give a total of 24. See area coordinator for approval prior to taking courses.

English

Coordinator: Robert Tremmel

Students seeking endorsement to teach English (7-12) must earn 46 credits in the following courses:

Distributed Requirements:

13 English Studies: 199 (required, but no credit); 219; 260; 310; 339 or 350

3 Advanced writing (selected from 302, 303, 304, 305, 306, 307, 309, 314, 315, 316)

3 Classical Studies: 353

6 British literature (selected from 370, 373, 374, 375, 376, 377, 378, 379)

6 American literature (selected from 360, 361, 362, 363, 364)

3 Any literature course

3 Women's and/or minority literature (selected from 340, 345, 346, 347, 348, 349, 460) (or 301, 366, 389, 461, 489 when appropriate)

21 English Education: 220; 394; 420; 392 (C I 280 for 2 cr. must be taken concurrently with 392); 494; C I 395

Students seeking to add English as an additional endorsement area must earn 33 credits in the following courses:

3 Sp Cm 212 or Thtre 358;

3 Advanced writing (selected from 302, 303, 304, 305, 306, 307, 309, 314, 315, 316)

9 English Studies: 220, 260, and 310

6 British literature (selected from 370, 373, 374, 375, 376, 377, 378, 379)

6 American literature (selected from 360, 361, 362, 363, 364)

3 Any literature course

3 World, women's, or minority litera

ture (selected from 340, 345, 346, 347, 348, 349, 353, 354);

12 English education 301 or 394; 392 (C I 280 for 2 cr. must be taken concurrently with 392), 494; C I 395

English as a Second Language

Coordinator: Roberta Vann

To add a K-12 teaching endorsement in English as a Second Language, students must fulfill the certification requirements in a major subject area and complete twenty-four semester hours in ESL.

Those twenty-four hours must include Engl 588.

In addition, students must take at least one course in each of the following areas and one additional course in any area. In some cases, relevant special topics courses or experimental courses may be substituted. Some courses have prerequisites.

Teaching ESL: Engl/Ling 518, 524, 525

Applied Linguistics: Engl/Ling 220, 419/516, 519, 520, 526

Language in Culture: ComSt 310; Anthr/Ling 309, 500; Engl 549, 349, Span 320.

Bilingual Education: Engl/Ling 514

Nature of Language: Engl/Ling 219, 420, 511, 512, 527

Process in Language Acquisition: Engl/Ling 425, 517

Family and Consumer Sciences

Coordinator: Sally K. Williams

See *Curriculum, Family and Consumer Sciences Education, Teacher Licensure option*.

Foreign Languages and Literatures

Coordinator: Dawn Bratsch-Prince

Students seeking approval to teach a foreign language must earn at least 34 credits in that one foreign language which must include the courses indicated below for that language. Licensure, full or restricted, also requires Foreign Language 487.

French: 301, 302, 305, 321 or 331, 322 or 332, 401.

German: 301, 302, 305, 330, 340, 4 credits from 471 or 472.

Spanish: 301, 303, 314, 320 or 326, 401, 403; 6 credits from 321, 322, 330, 331, 332.

Latin: 306 (2 cr.); 6 cr. each in 441, 442; 5 cr. arranged; Hist (CI St) 403.

Russian: 301, 302, 321, 322, 401, 402.

The Department of Foreign Languages and Literatures requires that all students seeking approval to teach a modern language demonstrate adequate speaking proficiency in that language.

Students seeking approval to teach one of the above foreign languages as an additional area must earn 25 credits in that language; 9 of these credits must be at the 300 level or above with 6 of these credits in composition and conversation at the 300 or 400 level. In Latin 10 credits must be at the 300 or 400 level and Hist 403 (CI St 403) is required. F Lng 487 is also required for this licensure.

Students seeking approval to teach Greek or Portuguese as an additional language must take 25 credits in the language; 9 of these credits must be 300 level courses or above. Endorsement in Greek also requires History 402. F Lng 487 is also required for this licensure.

General Science

Coordinators: Frederick DeLuca, Thomas Greenbowe, George Knaphus, David Meltzer

Students seeking approval to teach general science must earn credits in the following courses:

Biol 201, 201L, 202, 202L
Chem 163, 163L, 164, 164L, 231, 231L
Geol 100, 100L
Phys 111, 112; or 221, 222
Math 151 or 160 or 165

At least 6 credits from courses numbered 300 or above in astronomy and astrophysics, biochemistry and biophysics, biology, botany, chemistry, genetics, geology, meteorology, microbiology, physics, and zoology.

Health Education

Coordinator: Frank Schabel

Students seeking approval for health education as an additional subject area must earn credits in the following courses: H S 110, 215, 275, 305, 310, 350, 390; FS HN 167; HD FS 276; Zool 155, 156.

History and Social Sciences

Coordinator: Clair Keller

Students seeking certification in any of the social studies areas must complete 15 credits from the following courses listed in each of at least two approval areas plus (a) 15 credits distributed among any of the remaining areas, or (b) 15 credits taken from a single additional area. For each additional area of certification, students must complete 15 credits from courses listed.

Courses applicable in specific areas

Anthropology: Anthr 201, 202, 306 or 309, 307 or 308, and any other Anthr course.

Economics: Econ 101 and 102, and any other economics course except 392, 397, 496.

Geography: Select one course from each group: 1) Intro to Geog* or Anthr 306; 2) Political Geog* or Anthr 201; 3) Anthr 202; 4) Urban Geog* or Anthr 311 or 323 or 325 or 326; 5) EnScie 101 or 330 (*Geography courses are not available at ISU - see history/social science coordinator for available options).

Political Science: Credits as needed from: Pol S 215, 230, 241, 251, 305, 306, 310, 311, 320, 344, 357, 358, 359, 360, 361, 371, 381, 385, 405, 406, 410, 413, 420, 421, 433, 453, 464, 471.

Psychology: 101, 301, 440 and six additional credits except Psych 230 and 333.

Sociology: Soc 130 or 134 and credits as needed from 201, 235, 302, 305, 310, 327, 330, 331, 340, 345, 377, 380, 381, 401, 411, 415, 420, 425, 435, 461, 473, 484, 485.

United States History Credits as needed with

at least two courses from groups 1 and 2 and one course from group 3.

Group 1: 221, 351, 381, 450, 451, 454, 455, 462, 465, 467.

Group 2: 222, 307, 352, 457, 458, 459, 463, 464, 467, 470, 471.

Group 3: 353, 354, 365, 366, 370, 375, 382, 386, 460, 461, 472, 488, 489.

World History Credits as needed with at least one course from each group.

Group 1: 201, 304, 325, 401, 402, 403, 404, 405, 406, 408.

Group 2: 202, 305, 326, 381, 410, 411, 412, 414, 417, 419, 421, 422, 424, 426, 430, 431.

Group 3: 207, 208, 310, 311, 336, 337, 338, 340, 341, 441.

Students who have approval in other subjects and who wish additional approval to teach a specific area of the social studies must take LAS 493 and complete 24 semester credits in the area of approval or 15 semester credits in an approval area plus 15 semester credits from one additional area or distributed from other social studies areas.

Courses acceptable to fulfill human relations requirement: Pol S 385, Soc 330, Hist 353, 354, Hist 370,380, and Hist 460.

Human Development and Family Studies

Early Childhood Education. See *Curriculum, Human Development and Family Studies*.

Mathematics

Coordinator: William Rudolph

Students seeking approval to teach mathematics must earn credits in the following courses: Math 165, 166; 301; 302 or 307 or 317; 435, 436, 489; Com S 107 or 207 or 227; Math 304 or Stat 341; plus an additional 6 credits in courses numbered 200 or above in mathematics, computer science (except Com S 201), or statistics (except Stat 227).

Students seeking approval to teach mathematics as an additional area must earn credits in the following courses: Math 165, 166; 301; 307 or 302 or 317; 435, 489; Com S 107 or 207 or 227; Math 304 or Stat 341.

Music

Coordinator: Sylvia Munsen

Students seeking approval to teach music must earn credits in the following courses:

Music 119, 120, 219, 233, 234, 235, 236, 248, 266, 319, 333, 334, 335, 336, 361, 362, 366, 419, 466, 3 credits of advanced music history, and 3 credits of advanced music theory.

Music 327, 357B, 360, 367 and 365 are required for students planning to teach vocal music.

Music 350, 351, 352, 353, 354, 355, 356, 357A, 464, and either 368 or 369 are required for students planning to teach instrumental music.

Physical Education

See *Curriculum, Exercise and Sport Science, Physical Education Licensure*.

Physical Sciences

Coordinators: Frederick DeLuca, Thomas Greenbowe, David Meltzer

Students seeking approval to teach physical sciences must earn credits in the following courses:

Astro 120, 150; or 342, 346
Chem 163, 163L, 231, 231L
Geol 100, 100L
Mteor 206
Phys 111, 112; or 221, 222
Biology: one course
Math 151 or 160 or 165

Three credits from courses numbered 300 and above in astronomy and astrophysics, chemistry, meteorology, physics, and geology.

Students with an endorsement in a natural science who seek approval to teach physical sciences as an additional area must earn credits in the courses listed below. Students with no other science endorsement, but who seek an endorsement in this area, must take the listed courses plus additional credits in the area to yield a total of at least 24. See area coordinator for approval prior to taking additional courses. Astro 120 or 150 or 342 or 346

Chem 163, 163L
Geol 100, 100L
Mteor 206
Phys 111, 112; or 221, 222

Physics

Coordinator: David Meltzer

Students seeking approval to teach physics must earn credits in the following courses:

Phys 221, 222, 311T, 399 (2 cr), 321 or 324, and at least 12 credits from Phys 302, 304, 306, 310, 321L, 322, 322L, 361, 364, 365, 396; Astro 342, 344L, 346; Chem 321, 322; E E 205, 235, 441; E M 274, 301, 345, 378; M E 330, 331.

Students with an endorsement in a natural science who seek approval to teach physics as an additional area must complete one of the following sets of courses:

Phys 221, 222, 311T, 321, 321L, 399 (2 cr.); or Phys 111, 112, 302, 311T, 399 (2 cr.)

Students with no other natural science endorsement who seek approval to teach physics as an additional area must complete one of the two sets of courses listed above plus sufficient additional credits from the following list of courses to total 24 credits:

Phys 221, 222, 271, 272, 302, 304, 306, 310, 321, 321L, 322, 322L, 324; Astro 342, 344L, 346; Chem 321, 322; E E 205, 235, 441; E M 274, 301, 345, 378; M E 330, 331.

Reading (K-6; 7-12)

Coordinator: Donna Merkley

Students seeking endorsement to teach reading (7-12) as an additional area must earn credits in the following courses: Engl 219, 394; Engl 302 or 304 or 305 or 306 or 404 or 405; C I 378, 395, 396, 478. Students seeking reading approval for grades K-6, see elementary education adviser.

Speech Communication

Coordinator: Paul Kaufmann

Students seeking approval to teach speech must earn credits in the following courses:

CmDis 275; ComSt 102; Sp Cm 110, 212, 305, 313, 322, 412, 495A, 495B; Thre 255, 358, 360, 455; JI MC 101.

Advisers for Areas of Specialization in Teacher Education

Persons interested in teaching in one of the following areas should consult with the appropriate individual. Details of each area will be found in the appropriate departmental section.

Community College—Larry Ebbers (Arts and Sciences), John Van Ast (Applied Science and Technology/Vocational-Technical)

Elementary Education—Al Campbell, Melody Schobert

Early Childhood Education—Donna Merkley

Special Education/Learning Disabilities—Geoffrey Abelson

Special Education/Behavioral Disorders—Geoffrey Abelson

Talented and Gifted—Katheryn Kearney

Prekindergarten-Kindergarten

Early Childhood Education—Susan Hegland

Special Education/Early Childhood—Patricia Walsh

Teaching Pre-Kindergarten/Kindergarten Children—Patricia Walsh

Secondary Education

Agricultural Sciences/Agribusiness Education—Gregory S. Miller

Art—Dennis Dake

Biology—George Knaphus

Chemistry—Thomas Greenbowe

Coaching Interscholastic Athletics—Deborah Rhea

Earth Sciences—Frederick DeLuca

English—Robert Tremmel

English as a Second Language—Roberta Vann

Family and Consumer Sciences Education and Studies—Sally K. Williams

Foreign Languages—Dawn Bratsch-Prince

General Science—Frederick DeLuca, James Dixon, Thomas Greenbowe, George Knaphus

Health Education—Frank Schabel

History and Social Sciences (economics, sociology, government, geography, and history)—Clair Keller

Mathematics—William Rudolph

Music—Sylvia Munson

Physical Education—Deborah Rhea

Physical Sciences—Frederick DeLuca, Thomas Greenbowe, David Meltzer

Physics—David Meltzer

Reading—Donna Merkley

Speech Communication—Paul Kaufmann

Technology and Social Change

Undergraduate Study

Technology and social change is a cross-disciplinary program examining the relationships between technologies and the social and cultural environments in which they operate. The program has a national and international perspective, with courses addressing the interrelationships, policies, and impacts created by the international exchange of technologies. Through T SC, students will better understand the institutional and sociocultural consequences of technological change from differing perspectives and will become sensitive to the issues attending the use of technology to improve people's lives. Work in the program can also serve as preparation for advanced study in this field.

The program requirement for a minor in technology and social change is a minimum of 15 credit hours. One of the courses must be T SC 341. An additional 3 credits must be taken from T SC cross-listed courses. The remaining 9 may be selected from T SC cross-listed courses or from the list of T SC approved courses. At least 9 of the 15 credits must be in courses numbered 300 or above. Because technology and social change is an interdisciplinary study, minor programs must include coursework in at least two departments. Students seeking a minor should develop a specific program of courses either with the T SC faculty representative in their department or with the T SC coordinator. The student's minor program must be approved by the T SC program coordinator.

T SC courses are listed below. The list of T SC approved courses is available from the program coordinator. Through the coordinator, students may petition for approval of courses not on the approved list that address matters relevant to technology and social change.

Graduate Study

The graduate minor in technology and social change is a cross-disciplinary program that enables students to study the interactions between technologies and their users, on both societal and individual levels. The minor strengthens the ability of students to apply differing perspectives in understanding the effects of the global exchange of technologies and to heighten their sensitivity to the institutional and sociocultural issues attending the use of technology to improve people's lives.

Students choosing to minor in technology and social change will pursue a degree program in the major department. In consultation with their major professor, students are to identify a T SC Faculty member to serve on the committee guiding their program of study. This T SC Faculty member must be on the Graduate fac-

ulty and must be from a discipline outside the major field of study. With the agreement of the POS committee, the student declaring a minor in T SC will select a group of courses from the list of T SC approved courses available through the program coordinator. For the master's degree, this group should be at least 9 credit hours; for a doctoral degree, the group should be at least 15 credit hours. In either case, T SC/Soc 541 is required. Students may not include in their minor any courses from their own major. All programs of study that include a T SC minor must be approved by the T SC Program coordinator.

Courses open for nonmajor graduate credit: 342, 442.

Courses Primarily for Undergraduate Students

T SC 341. **Technology: International, Social, and Human Issues.** (Same as LAS 341.) (3-0) Cr. 3. F. *Prereq: Junior classification.* An interdisciplinary study of the international significance of technology and of the societal and human issues attending its development and adoption.

T SC 342. **World Food Issues: Past and Present.** (Same as Agron 342.) See *Agronomy*. Nonmajor graduate credit.

T SC 442. **Philosophy of Technology.** (Same as Phil 442.) See *Philosophy*. Nonmajor graduate credit.

T SC 474. **Impact of Communication Technology on People and Societies.** (Dual-listed with 574, same as JI MC 474.) See *Journalism and Mass Communication*.

T SC 490. **Independent Study.** Cr. var. *Prereq: 341, permission of instructor and of T SC coordinator.*

Courses Primarily for Graduate Students, Open To Qualified Undergraduate Students.

T SC 541. **Technological Innovation, Social Change, and Development.** (Same as Soc 541.) See *Sociology*.

T SC 543. **Development Advisory Team (DAT) Training Workshop.** (Same as Anthr 543.) See *Anthropology*.

T SC 574. **Impact of Communication Technology on People and Societies.** (Dual-listed with 474, same as JI MC 574.) See *Journalism and Mass Communication*.

T SC 590. **Special Topics: Technology and Social Change.** Cr. var. *Prereq: 541, permission of instructor and of T SC coordinator.* Individual study of topics concerning global and local implications of technological change.

Courses for Graduate Students

T SC 640. **Seminar in Technology and Social Change.** Cr. var. *Prereq: 541.* Consideration of global issues and consequences arising from technological change. Specific topics vary each time offered.

T SC 641. **Implementing International Agricultural and Rural Development Projects: Problems and Issues.** (Same as Anthr 641.) See *Anthropology*.

Textiles and Clothing

LuAnn R. Gaskill, Chair of Department

University Professors: Farrell-Beck

Professors: Littrell, Stone

Distinguished Professors (Emeritus):
Warning, Winakor

Professors (Emeritus): Danielson, Hollen,
Huepenbecker

Associate Professors: Damhorst, Fiore,
Gaskill, Kadolph, Kunz

Associate Professors (Emeritus):
Brackelsberg

Assistant Professors: Campbell, Miller

Instructors (Adjunct): Fratzke, Glock

Undergraduate Study

The department offers study for the degree bachelor of science with a major in apparel merchandising, design, and production. The program offers students a broad understanding of textile and apparel products, merchandising and marketing strategies, production processes, and business practices leading to a wide range of careers at state, national, and international levels in business, and industry. Courses in the department provide scientific, technical, and humanistic knowledge about textiles, apparel, and related products basic to career preparation. Courses also provide knowledge applicable to the development and use of apparel and textile products by individuals, families, and institutions. The program can be used as a foundation for graduate study. Graduates understand the production, distribution, and use of textiles and apparel, with special attention to human concerns for protection and comfort, health and safety, aesthetic expression and communication. They are prepared to plan, develop, and present textile and apparel products to meet the needs of the consumer. They understand the issues involved in textile and apparel production and marketing, both nationally and internationally. Graduates appreciate the interdependence of nations and cultures as producers and consumers of textiles and clothing.

The major in apparel merchandising, design, and production (AMDP) provides a broad-based program of study with flexibility in creating an individualized program option. Courses are required in the following groups: general education, family and consumer sciences core, and the AMDP core. To complete the program, a student combines structured clusters of courses to form a program option. A student might develop an option in merchandising, design, or production, as indicated by the program title.

An option in merchandising prepares students for the planning, development, and presentation of market-oriented product lines. Career opportunities are in product development, buying, promotion, and management in both manufacturing and retailing sectors of the textile and apparel industry.

An option in apparel design is appropriate for those interested in the aesthetic, creative, and technical aspects of textiles and clothing through design, product or line development, or in promotion.

An option in production prepares students for positions related to apparel engineering, plant management, quality assurance, costing, product development, sourcing, and buying piece goods or trim for apparel manufacturing or retailing firms.

In addition, a student might focus on international studies, consumer behavior, or other areas. For example, a natural science/math orientation might prepare students for careers in textile processing, quality assurance, materials testing, and materials buying. A social science orientation may prepare students for positions in consumer relations, personnel and training, marketing research, international business, museums, or extension.

The department offers a minor in apparel merchandising, design, and production. The minor can be earned by taking T C 131 or 165; 104 or 204; 225, 231, or 245; 6 credits at the 300-400 level; and an additional 2 to 3 credit T C course for a total of 16 to 20 credits. Also available is an apparel merchandising, design, and production designated area of concentration combined with a major in journalism and mass communication in the College of Liberal Arts and Sciences; see department for details.

Grade point requirement: All students majoring in apparel merchandising, design, and production are required to earn a C- or better in all TC courses applied toward the degree, including transfer credits.

English proficiency: Undergraduate English proficiency is certified when the student has received a grade of C- or better in English 104 and 105. Students who receive a D+, D, or D- in English 104 or 105 may take English 302, 309, 314 instead of repeating the lower level course.

Graduate Study

The department offers the degrees master of science and doctor of philosophy with a major in textiles and clothing, as well as minor work for students with majors in other departments.

The department also participates in the Master of Family and Consumer Sciences degree by offering a specialization within that program.

The field of study is highly interdisciplinary; programs of study are tailored to students' background and interests.

Graduates understand how textiles and apparel are essential in meeting individual and societal needs and understand the interdependence of nations and cultures as producers and consumers. They contribute to developing an integrated body of knowledge and theory in a field that is interdisciplinary. Graduates understand diverse philosophies of scholarship and apply multiple methods to research and teaching. Strong writing and oral communication skills help graduates disseminate scholarship and compete successfully for awards and grants.

Graduates are marketable for positions relevant to their academic experience. All doctoral graduates have teaching experience. Masters and doctoral graduates can work effectively in team-oriented and interactive environments. Graduates are prepared to adapt to future changes in their professions and to provide leadership in professional and public practice. They bring a strong sense of ethics to research, teaching, and business endeavors.

Program emphases for graduate study include consumer behavior toward textiles and apparel; craft marketing; small business management, merchandising, and marketing aspects of textiles and clothing; acquisition and use of textiles and apparel within cultures; U.S. costume and textiles of the 19th and early 20th centuries; textiles; social/psychological aspects of dress; aesthetics; product quality and development; textile conservation; and computer-aided design.

The department participates in the interdepartmental minor programs of gerontology and housing.

Courses open for nonmajor graduate credit: 354.

Courses Primarily for Undergraduate Students

T C 121. **Apparel Assembly Processes.** (1-4) Cr. 3. F.S. Principles of garment assembly. Use of mass production equipment and methods to develop and assemble garments. Materials fee.

T C 131. **Introduction to Apparel Product Development.** (2-2) Cr. 3. F.S. Concepts related to and issues in the development of apparel products for consumers. Basics of computer-aided design for product development.

T C 165. **Appearance in Society.** (3-0) Cr. 3. F.S. Social science approaches to understanding clothing and appearance in contemporary U.S. society. Examination of diversity among consumers and forecasting future trends in consumer behavior. Materials fee.

T C 204. **Textile Science.** (3-3) Cr. 3 or 4. 4 credits for majors; 3 credits for non-majors. F.S. *Prereq:* *Sophomore standing.* Textile fibers, yarns, fabrication, coloration, and finishes. Quality and performance evaluation of apparel, furnishing, and industrial textiles. Materials fee. Credit for both 104 and 204 may not be applied toward graduation.

T C 225. **Flat Pattern.** (2-4) Cr. 4. F.S. *Prereq:* 121, 131; 204 recommended. Flat pattern methods for women's, men's and children's wear. Pattern drafting and knock-offs; pattern making and grading by computer. Materials fee.

T C 231. **Apparel Manufacturing.** (2-2) Cr. 3. F.S. *Prereq:* 204, 131. Analysis of apparel manufacturing processes, product development, sourcing, and production. Focus on specifications relative to quality, performance, and cost. Field trip fee.

T C 245. **Aesthetics of Apparel.** (3-2) Cr. 4. Alt. F.S., offered 2000. *Prereq:* 131, 165. Analysis and development of multisensory aesthetic aspects of apparel products and promotional settings affecting the consumer. Computer-aided design applied to designer analysis, and development and presentation of apparel products.

T C 257. **Introduction to Museums.** (Same as Anthr 257.) (3-0) Cr. 3. F. *Prereq:* *Sophomore standing.* History and theory of museums. Overview of museums in modern society, careers in museums, and future needs. Field trip fee.

T C 275. **Textile and Apparel Industries.** (3-0) Cr. 3. F.S. *Prereq:* 131 recommended. History and organization of the textile and apparel industry; focus on apparel merchandising, design, and production; international business and trade issues.

T C 278. Fashion Illustration. (0-6) Cr. 3. F. Alt. S., offered 2000. *Prereq:* 131, 245. Drawing the fashion figure and apparel using mixed media and computer aided design. Studies and compositions appropriate to advertising, fashion presentation, and portfolio development. Survey of historical and contemporary fashion artists. Materials fee.

T C 305. Quality Assurance of Textiles and Apparel. (Dual-listed with 505.) (2-2) Cr. 3. F.S. *Prereq:* 231, one course from the natural sciences select from list: *Stat 101, 227, or 401.* Principles of product and materials evaluation and quality assurance. Developing specifications and following standard practices for evaluating materials, product characteristics, performance, and quality. Materials fee.

T C 321. Apparel Technology Applications. (0-6) Cr. 3. F. *Prereq:* 225, 231; 245; *Com S 103.* Analysis and advanced use of industry specific software for textile and fashion design. Materials fee.

T C 325. Draping. (1-5) Cr. 3. S. *Prereq:* 204, 225, 278. Principles of pattern making by draping techniques; interaction of fabric characteristics with style features; fit; comparison to flat pattern techniques. Materials fee.

T C 326. Experimental Design and Presentation. (2-2) Cr. 3. F. *Prereq:* 225, 278; 325 recommended. Use of nontraditional and recycled materials to create innovative garments and accessories. Development of collections suitable for inclusion in a portfolio, using manual and computer-aided techniques. Materials fee.

T C 331. Apparel Engineering and Management. (2-3) Cr. 3. S. *Prereq:* 231; *Com S 103; T C 121 recommended.* Procedures and experiences related to method analysis, work measurement, costing, and production planning; resource management, technology applications, and quality assurance. Field trip fee, materials fee.

T C 342. Aesthetics of Everyday Experience. (3-0) Cr. 3. F.S. Design principles, aesthetic concepts, and philosophies applied to everyday living. Influence of individual differences and cultural patterns on aesthetic preferences.

T C 354. History of European and North American Costume. (3-0) Cr. 3. S. *Prereq:* 3 credits chosen from *Hist or Art H.* Clothing and adornment of women, men, and children in the Ancient Near East, Egypt, Europe, and the United States, from prehistoric times to present: social, economic, technological, and cultural context of costume. Nonmajor graduate credit.

T C 355. History of Asian Costume. (Dual-listed with 555.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 204; 3 credits from *Hist or Art H.* Clothing and adornment of men, women, and children in selected countries of Asia, from antiquity to the early 20th century; includes Turkey, Iran, China, Japan, Korea, and Indonesia.

T C 362. Cultural Perspectives in Clothing and Textiles. (3-0) Cr. 3. S. *Prereq:* 165 or 3 credits in *anthropology, psychology, or sociology.* Analysis of multiple factors related to clothing and textiles in selected societies, including technology, aesthetics, social organization, ritual, stability and change. Applications to apparel business.

T C 375. Merchandising. (Dual-listed with 575.) (3-0) Cr. 3. F.S. *Prereq:* 165; *Com S 103, 3 credits in Math; junior classification.* Principles of merchandising as applied in manufacturing and retailing business organizations. Study of planning and development of primarily apparel and related product lines. Computer applications in merchandising.

T C 376. Merchandise Planning and Control. (3-0) Cr. 3. F. *Prereq:* 375 or *Mkt 446.* Theories and procedures in planning, purchasing, and controlling retail inventories for the profitable management and operation of apparel and related product lines. Computer applications in strategic retail management. Materials fee.

T C 377. Merchandise Presentation. (2-2) Cr. 3. S. *Prereq:* 245 and 375. Merchandise presentation and promotion at wholesale and retail levels as related to image, sales, and aesthetics. Group project presenta-

tions of apparel and related products to diverse markets. Materials fee.

T C 380. Field Study. Cr. 2. May be repeated. F.S.SS. *Prereq:* 9 credits in *textiles and clothing, junior classification. Permission by application.* Study of and tours to textile mills, apparel manufacturers, design studios, showrooms, markets, retailers, museums, testing laboratories, trade seminars and exhibitions and other areas of interest within the textile and apparel industry. Field trip fee.

T C 381. International Field Study. Cr. 2. May be repeated. S.SS. *Prereq:* 9 credits in *textiles and clothing, junior classification. Permission by application.* Study of and tours to textile mills, apparel manufacturing, design studios, showrooms, markets, retailers, museums, testing laboratories, trade seminars and exhibitions and other areas of interest within the textile and apparel industry. Countries vary. Field trip fee.

T C 395. Design Exhibition. Cr. R. F.S.SS. *Prereq:* 225, 278, *junior classification.* Acceptance of work in a local, regional, or national design contest: enter a minimum of one example of original work, i.e., garment, illustration, or portfolio.

T C 398. Cooperative Education. Cr. R. F. S. SS. *Prereq: Permission of department executive officer; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

T C 404. Advanced Textile Science. (Dual-listed with 504.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 204, 245; one course in *natural sciences select from group.* Theories and principles of textile science; emphasis on fiber, dye, and detergency chemistry. Examination of product failure, current research, and environmental impact. Materials fee.

T C 410. Synthesis of Merchandising, Design, and Production. (2-3) Cr. 3. F.S. *Prereq: Senior classification; permission by application; 165, 231, 245, 375.* Multi-functional team approach to creative problem solving and development of apparel; integration, application, and presentation of facts and concepts. Materials fee.

T C 411. Seminar on Current Issues. Cr. 1 to 3 each time taken. *Prereq: Senior classification, 12 credits in textiles and clothing.* Trends and issues in textiles and apparel.

T C 467. Consumer Behavior and Apparel. (Dual-listed with 567.) (2-2) Cr. 3. F. *Prereq: Stat 101 or 227; T C 165 or 3 credits in marketing, psychology, or sociology.* Application of concepts and theories from the social sciences to the study of consumer behavior toward apparel and adornment. Experience in conducting research. Materials fee.

T C 468. Functional Design for Special Needs. (Dual-listed with 568.) (2-2) Cr. 3. Alt. S., offered 2001. *Prereq:* 204; 225 or 305. Development of apparel and textile prototypes for industrial, medical, and athletic uses to enhance comfort, mobility, visibility, impact, and safety. Design and evaluation of apparel for children, elderly, recovering medical patients, and individuals with physical or mental challenges. Materials fee.

T C 470. Supervised Experience. Cr. 2 to 6. F.S.SS. *Prereq: Minimum 2.0 GPA; permission by application; junior or senior classification.* Supervised work experience with a cooperating firm in merchandising, design, manufacturing, product development or quality assurance.

- A. Textile Industry. *Prereq:* 305.
- B. Historic Textiles and Clothing. *Prereq:* 6 credits from 354, 355, 362; 3 credits in *anthropology recommended.*
- C. Apparel Design. *Prereq:* 225, 231, 245, 278.
- I. Merchandising. Cr. 4 or 6. *Prereq:* 375.
- J. Extension. *Prereq:* 6 credits in *textiles and clothing.*
- M. Museum. Cr. 2 to 6. *Prereq:* 257.
- N. Apparel Production Management. *Prereq:* 331.
- O. Product Development. *Prereq:* 231, 225, 245, or 305.
- Q. Quality Assurance. *Prereq:* 305.
- T. Public Relations. *Prereq:* T C 375 and *Jl MC 330.*

T C 472. Global Issues in Textiles and Apparel. (Dual-listed with 572.) (3-0) Cr. 3. F. *Prereq:* 275, *Econ 101.* Evaluation of key issues facing textiles and apparel businesses in global markets considering ethical, economic, political, social, and professional implications.

T C 490. Independent Study. Cr. arr. May be repeated. F.S. *Prereq:* 6 credits in *textiles and clothing, permission of the instructor, adviser, and department executive officer.*

- A. Textile Science
- B. History of Textiles
- C. Apparel Design and Assembly
- D. Aesthetics
- E. History of Costume
- F. Sociological and Psychological Aspects of Clothing and Textiles
- G. Consumer Behavior
- H. Honors
- I. Merchandising
- K. Cultural Analysis
- N. Apparel Production Management
- O. Product Development
- Q. Quality Assurance
- R. Functional Design
- S. Small Business Entrepreneurship in Apparel

T C 495. Advanced Design Exhibition. (1-0) Cr. 1. F.S.SS. *Prereq:* 225, 278, *senior classification.* Acceptance of a line of products or a comprehensive portfolio in a local, regional, or national design contest.

T C 498. Cooperative Education. Cr. R. F.S.SS. *Prereq: Permission of department executive officer; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

T C 499. Undergraduate Research. Cr. 1 to 3 each time taken. F.S.SS. *Prereq: Senior classification, 15 credits in textiles and clothing, permission of instructor, adviser, and department executive officer.* Research experience in textiles and clothing with application to a selected problem.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

T C 504. Advanced Textile Science. (Dual-listed with 404.) (3-0) Cr. 3. Alt. S., offered 2001. *Prereq:* 204, 245; one course in *natural sciences select from group.* Theories and principles of textile science; emphasis on fiber, dye, and detergency chemistry. Examination of product failure, current research, and environmental impact. Materials fee.

T C 505. Quality Assurance of Textiles and Apparel. (Dual-listed with 305.) (2-3) Cr. 3. Alt. F., offered 2000. *Prereq:* 231, 375; *Stat 101, 227 or 401; one course from the natural sciences select from list.* Principles of product and materials evaluation and quality assurance. Developing specifications and following standard practices for evaluating materials, product characteristics, performance, and quality. Proposal and research project. Materials fee, field trip fee.

T C 510. Survey of Research in Textiles and Clothing. (2-0) Cr. 2. F. *Prereq: Graduate classification.* Overview of research in textiles and clothing with emphasis on current and future directions and interdisciplinary nature of the field. Introduction to theory and model building.

T C 545. Interdisciplinary Approach to Aesthetics of Textiles and Clothing. (3-0) Cr. 3. Alt. SS., offered 2000. *Prereq: Undergraduate course in design elements and principles.* Examination of aesthetics theory from an interdisciplinary perspective. Emphasis on theory from disciplines outside textiles and clothing. Discussion of implications for development and promotion of apparel products and promotional settings.

T C 555. History of Asian Costume. (Dual-listed with 355.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 3 credits from *Hist or Art H.* Clothing and adornment of men, women, and children, in selected countries of Asia, from antiquity to the early 20th century; includes Turkey, Iran, China, Japan, Korea, and Indonesia.

T C 557. Conservation of Textiles and Costume. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 204; 354 or 355. Preventive and interventive approaches to textile conservation. Focus on understanding textiles and costume and factors related to aging, storage, and exhibition; research methods. Materials fee.

T C 562. Dress and Culture. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 362 or 6 credits in social science or cultural anthropology. Analysis of dress as artifact, behavior, and symbol in selected cultures.

T C 564. Clothing Consumption. (3-0) Cr. 3. *Prereq:* Econ 101, Stat 101 or 227. Theories of clothing consumption; factors affecting family expenditures and levels and standards of consumption for clothing and household textiles.

T C 567. Consumer Behavior and Apparel. (Dual-listed with 467.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* Stat 101, T C 165 or 3 credits in marketing, psychology or sociology. Application of concepts and theories from the social sciences to the study of consumer behavior involving apparel and adornment. Experience in conducting research: grant proposal and manuscript writing. Materials fee.

T C 568. Functional Design for Special Needs. (Dual-listed with 468.) (2-2) Cr. 3. Alt. S., offered 2001. *Prereq:* 104 or 204; 225 or 305. Development of apparel and textile prototypes for industrial, medical, and athletic uses to enhance comfort, mobility, visibility, impact, and safety. Design and evaluation of apparel for children, elderly, recovering medical patients, and individuals with physical or mental challenges. Materials fee.

T C 570. Practicum in Textiles and Clothing. Cr. 1 to 3. F.S.SS. *Prereq:* 7 graduate credits in textiles and clothing, permission by application. Supervised experience related to career objective. Proposal must be approved semester before placement.

T C 572. Global Issues in Textiles and Apparel. (Dual-listed with 472.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 231; 375, or 575. Evaluation of key issues facing textile and apparel businesses in global markets considering ethical, economic, political, social, and professional implications. Theoretical foundations of sourcing.

T C 574. Management of Small Apparel Businesses. (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 6 credits in textiles and clothing. Concepts and processes of effective planning, operations, and management of textile and apparel small businesses from domestic and international perspectives. Analysis of research and theory.

T C 575. Merchandising. (Dual-listing with 375.) (3-0) Cr. 3. Alt. F., offered 2001. *Prereq:* 165; Com S 103 and 3 credits of Math. Principles of merchandising as applied in manufacturing and retailing business organizations. Study of planning and development of primarily apparel and related product lines. Computer applications and theoretical foundations in merchandising.

T C 581. International Study. Cr. var. S.SS. *Prereq:* 9 credits in textiles and clothing, permission by application. Study abroad of apparel and textile design, merchandising, production, distribution, and consumption: textiles in museums. Countries vary. Field trip fee. May be repeated.

T C 590. Special Topics. Cr. arr. *Prereq:* Permission of department executive officer and instructor(s). Individually designed textile and clothing related projects that reflect the special interests of the student.

- A. Textile Science
- B. History of Textiles
- C. Apparel Design and Construction
- D. Aesthetics
- E. History of Costume
- F. Sociological and Psychological Aspects
- G. Consumer Behavior
- I. Merchandising
- J. Extension
- K. Cultural Analysis
- L. Conservation
- M. Museums
- N. Apparel Production Management
- O. Product Development
- P. Interdisciplinary

- Q. Quality Assurance
- R. Functional Design
- S. Small Business/Entrepreneurship in Apparel

T C 593. Workshop. Cr. arr. SS.

Courses for Graduate Students

T C 610. Philosophical Issues of Textiles and Clothing Research. (2-0) Cr. 2. Alt. S., offered 2000. *Prereq:* 511, 6 graduate credits in textiles and clothing; one course in philosophy. Models, theory, methods, alternative philosophies, and ethics of science as applied in textiles and clothing research.

T C 611. Seminar. Cr. 1 to 3 each time taken. *Prereq:* 6 graduate credits in textiles and clothing, permission of instructor. Discussion of research and current issues. Topics vary.

T C 650. Advanced History of Costume and Textiles. (3-0) Cr. 3. Alt. F., offered 2000. *Prereq:* 204; 354 or 355. Philosophy and techniques of history-based research applied to clothing and textiles; inter-relationship of artifacts and documents; individual and group projects.

T C 665. Social and Psychological Theories of Appearance. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 467 or 6 credits in sociology or psychology. Analysis of social science theories and concepts applicable to clothing and appearance research.

T C 690. Advanced Topics. Cr. arr. *Prereq:* Enrollment in doctoral program, permission of instructor, and approval of department executive officer.

T C 699. Research.

Theatre and Performing Arts

(Administered by the Department of Music)

Undergraduate Study

Students interested in theatre as a major area of concentration declare a major in Performing Arts and select an emphasis in Theatrical Design or Acting/Directing. Students implement the theories and principles explored in the classroom by participating in production work. During the academic year, Iowa State University Theatre presents up to ten main-stage and second stage productions in Fisher Theater, and works in close collaboration with ISU Music and Dance.

The major in Performing Arts offers the undergraduate student a cross-disciplinary concentration in Music, Dance and Theatre. The core curriculum consists of 24 credit hours in the three areas. Students elect a 24 credit hour emphasis in either Dance, Theatrical Design or Acting/Directing. In addition to coursework, all Performing Arts majors and minors participate in concert (Orchestra, Footfalls), workshop (Opera Studio, Minority Theatre Workshop) and production (Barchje, Stars Over Veishea, ISU Theatre/Music Theatre/Second Stage and Studio) experiences.

Performing Arts students, in addition to a solid theoretical and experiential background in the areas of performance, theatrical design, dance and music, are prepared to meet the challenges of the work force or graduate school with their strengths in collaboration, creative problem solving, meeting deadlines and processing diverse input to yield cohesive output. Two required professional internships prior to graduation are vital to the student's apprecia-

tion and practical understanding of the rigors of the field.

The theatre area offers a wide variety of courses. Students may select from a core of courses in acting, design (costume, scenic, lighting/sound), make-up, stage direction, stage management, and theatre history. Independent study and special topics courses supplement formal course offerings to provide opportunities to intensify study in a particular aspect of theatre.

Auditions for ISU Theatre productions are open to all students irrespective of academic major. Similarly, participation in areas of production other than acting is open to both majors and nonmajors. Qualified students also present experimental, laboratory, and Minority Theatre Workshop productions. Student actors, directors, designers, and technical crew heads are required to maintain a grade point average of at least 2.0 to participate in productions.

Theatre scholarships are awarded on a yearly basis to students who make significant contributions to Iowa State University Theatre.

Bachelor of Arts - Performing Arts Major (Perf)

The Core for the Performing Arts Major (24 cr)

(for individual Dance and Music course descriptions, see *Index* for individual department listing.)

Music 100, 102, 127
Dance 120–Modern Dance I, 130–Ballet I, 220–Modern Dance Composition
Dance 270–Dance Appreciation
Thtre 255, 263, 365
Perf 105–(six semesters), Perf 310 (2), Perf 401
Emphasis in Theatrical Design (24 cr)
Thtre 250 (2 cr), 360, 366, 455, 461, 465, 466, Music 133
Emphasis in Dance (24 cr)
Art 292, Music 133, Ex Sp 355
Dance 222, 224 (2 cr), 232, 360, 370
Select 2 credits from: Dance 140, 150, 160, 170, 211 (instead of 160, 170)
Select 2 credits from: Dance 223, 233, 242, 243, 262
Select 3 credits from: Dance 320, 384, 385, 386
All students enrolled in the Dance Emphasis must register for one dance technique course every semester of residence up to a total of 8 credits and must complete one computer course (Com S 103, 107, 205, 207, C I 201).
Emphasis in Acting/Directing (24 cr)
Thtre 151, 250 (2 cr), 251, 351, 451, 455, 465, 466
Music 133
Minor in Performing Arts (21 cr)
Perf 105 (three semesters)
Music 100, 102
Dance 120 or 130, 270
Thtre 255, 263 or 251
plus six credits 300+ in Dance, Thtre or Perf
English proficiency requirement: Select one course from “Advanced Writing” Engl 302,

303, 304, 305, 306, 307, 309, 314, 315, 316, 366, 367.

Graduate Study

The department offers graduate courses as supporting work in other fields.

Courses open for nonmajor graduate credit: Thtre 316, 465, 466; Perf 401.

Performing Arts

Courses Primarily for Undergraduate Students

Perf 105. Issues in the Performing Arts. (1-0) Cr. R. F.S. Cross-disciplinary analysis and discussion of topics in the performing arts. Six semesters required of performing arts majors.

Perf 310. Performing Arts Internship. Cr. R. F.S.S.S. Required of performing arts majors. A job or internship with a professional or semi-professional performing arts organization.

Perf 401. Performing Arts Seminar. (2-0) Cr. 2. Alt. S., offered 2001. Intensive collaborative study and practice of topics in music, dance and theatre. Required of performing arts majors. Nonmajor graduate credit.

Theatre

Courses Primarily for Undergraduate Students

Thtre 106. Introduction to the Performing Arts. (3-0) Cr. 3. F.S.S.S. An audience oriented, broad-based, team-taught survey of the performing arts which emphasizes theatre and includes segments on television, radio, film, dance, and music.

Thtre 110. Theatre and Society. (3-0) Cr. 3. F.S.S.S. An introduction to Theatre focusing on its impact on society from the Greeks to modern times. Particular emphasis on the contemporary world theatre.

Thtre 151. The Actor's Voice. (3-0) Cr. 3. S. Study and practice of fundamentals of vocal production: breathing, quality, articulation, projection, and expressiveness for the performing artist.

Thtre 224. Concert and Theatre Dance. (Same as Dance 224.) See *Health and Human Performance, Dance*.

Thtre 250. Theatre Practicum. Cr. 1 or 2 each time taken, maximum of 6 credits. F.S. *Prereq: Permission of instructor.* Practice in various aspects of technical theatre production. Offered on a satisfactory-fail grading basis only.

Thtre 251. Acting I. (3-0) Cr. 3. F.S. Theory and practice in fundamentals of acting.

Thtre 252. African American Theatre Production. (Same as Af Am 252.) (3-0) Cr. 3. F.S. An exploration of African American Theatre in production: aesthetic foundations, history and contributions to American Theatre.

Thtre 255. Introduction to Theatrical Production. (3-3) Cr. 4. F.S. Standard structure and procedures, historical overview of performing arts production including the design and creation of scenery, costumes and lighting. Materials fee.

Thtre 263. Script Analysis. (3-0) Cr. 3. F.S. Theory and analysis of scripts for production.

Thtre 290. Special Projects. Cr. 1 to 3 each time taken, maximum of 6 credits. F.S.S.S. *Prereq: 3 credits in theatre; permission of instructor; approval of written proposal.*

Thtre 316. Creative Writing—Playwriting. (Same as Engl 316.) (3-0) Cr. 3. S. *Prereq: Engl 105, not open to freshmen.* Progresses from production of scenes to fully developed one-act plays. Emphasis on action, staging, writing, analytical reading, workshop criticism, and individual conferences. Nonmajor graduate credit.

Thtre 351. Acting II. (3-0) Cr. 3. S. *Prereq: 251, Dance 120 recommended.* Theory and practice of techniques of acting with emphasis on character and scene analysis.

Thtre 352. Stage Combat. (1-2) Cr. 2. Alt. S., offered 2000. *Prereq: 351.* Theory, history, and practice of theatrical combat. Includes tumbling, hand-to-hand, quarterstaff, broadsword, rapier, and dagger.

Thtre 354. Musical Theatre I. (2-2) Cr. 3. Yr. *Prereq: 251 or Music 236 or 3 credits in Dance.* Theory, history and practice of musical theatre techniques. Designed to develop the musical theatre performance skills of singers, dancers, and actors.

Thtre 355. Musical Theatre II. (2-2) Cr. 3. Yr. *Prereq: 354.* Theory, history and practice of musical theatre techniques. Designed to develop the musical theatre performance skills of singers, dancers, and actors.

Thtre 357. Stage Make-up. (1-2) Cr. 2. F. Theory and practice of make-up and hair-styling techniques for the performing arts: Theatre, Opera, Dance, Television and Film. Lab required.

Thtre 358. Oral Interpretation. (3-0) Cr. 3. F. Principles of oral interpretation: practice in analysis, in reading aloud of literary selections, and in reader's theatre.

Thtre 359. Theatre for Children and Youth. (3-0) Cr. 3. S. Study and practice of directing, acting, and the production of theatre for children and youth.

Thtre 360. Stagecraft. (3-2) Cr. 4. S. *Prereq: 255.* Tools, materials, and techniques of planning, constructing and painting of performing arts scenography. Basic principles of lighting technology. Technical drawing for performing arts production. Materials fee.

Thtre 365. Theatrical Design I. (2-2) Cr. 3. F. *Prereq: 255.* An exploration of the elements, principles and art of theatrical design.

Thtre 366. Theatrical Design II. (2-2) Cr. 3. S. *Prereq: 365.* Intensive application of the principles introduced in 365. In-depth study and practice of the graphic skills of rendering and drafting.

Thtre 367. Stage Management. (3-0) Cr. 3. F. *Prereq: 255.* The responsibilities and techniques of stage management for the performing arts.

Thtre 393. Workshop. Cr. 3 each time taken, maximum of 9. F.S.S.S. *Prereq: 3 credits in theatre.* Offered to explore special topics.

- A. Minority Theatre
- B. Repertory
- C. Children's Theatre
- D. Musical Theatre
- E. Creative Dramatics
- F. International Storytelling

Thtre 451. Acting III. (3-0) Cr. 3. F. *Prereq: 351 and permission of instructor.* Analysis and practice of period scenes.

Thtre 455. Directing I. (3-0) Cr. 3. F. *Prereq: 255; 263; 251 recommended.* Theory, techniques, and practice of directing.

Thtre 456. Directing II. (2-2) Cr. 3. S. *Prereq: 455.* Practical and theoretical experience in directing the stage play.

Thtre 461. Theatrical Design Studio. (3-2) Cr. 4 each time taken, maximum of 12. F.S. *Prereq: Permission of instructor.* Focuses on the art and craft of specific areas of theatrical design. Each semester the student will focus on one or two of the following: scenic, costume, or lighting design.

Thtre 465. History of Theatre I. (3-0) Cr. 3. F. *Prereq: Hist 201 or equivalent.* Theatre history from ancient times to 1800. Nonmajor graduate credit.

Thtre 466. History of Theatre II. (3-0) Cr. 3. S. *Prereq: 465.* Theatre history from 1800 to present. Nonmajor graduate credit.

Thtre 469. Advanced Theatre Practicum. Cr. 1 to 3 each time taken, maximum of 3 credits per semester, maximum of 6 credits total. F.S.S.S. *Prereq: 9 credits in theatre courses; junior classification.* Practicum in production with ISU Theatre, with opportunities for specialization within various areas. Required: Approval of written proposal.

Thtre 490. Independent Study. Cr. 1 to 3 each time taken. F.S.S.S. *Prereq: 9 credits in theatre, approved written proposal, junior classification.* Only one independent study enrollment within the department is permitted per semester; no more than 9 credits in Thtre 490 may be counted toward graduation.

Thtre 497. Senior Seminar. (3-0) Cr. 3. S. *Prereq: 15 credits in theatre courses; senior classification.* Directed study of a theatre issue or problem identified by each student. Students synthesize relevant theory and research culminating in senior project or paper.

Thtre 499. Theatre Internship. Cr. var. 1 to 8 each time taken, maximum of 8. F.S.S.S. *Prereq: 18 credits in theatre, other courses deemed appropriate by faculty adviser; 2nd semester junior or senior standing; cumulative GPA of at least 2.5 overall and 3.0 in theatre courses.* Supervised application of theatre in professional settings.

Courses Primarily for Graduate Students, open to qualified undergraduates

Thtre 504. Seminar. Cr. 1 to 3 each time taken. F.S.S.S. *Prereq: 9 credits in theatre.* Topics may include the following:

- A. Musical Theatre
- B. Acting Techniques
- C. Acting Styles
- D. Design and Technical Theatre
- E. Arts Management

Thtre 590. Special Topics. Cr. 1 to 4 each time taken, maximum of 12 credits. *Prereq: Approved written proposal.*

Toxicology

(Interdepartmental Graduate Major)

Supervisory Committee: F. Ahrens, Chair; G. Atchison, J. Coats, C. D. Drewes, W. Hyde, G. Munkvold

Work is offered for the degrees master of science and doctor of philosophy with major in toxicology in various cooperating departments: Agricultural and Biosystems Engineering; Animal Ecology; Animal Science; Biochemistry, Biophysics and Molecular Biology; Biomedical Sciences; Botany; Chemistry; Entomology; Food Science and Human Nutrition; Geological and Atmospheric Sciences; Microbiology; Plant Pathology; Veterinary Diagnostic and Production Animal Medicine; Veterinary Pathology; and Zoology and Genetics.

The prerequisites for entrance into the graduate toxicology major include an undergraduate degree in a relevant area of study; for example, chemical engineering, biology, biochemistry, chemistry, ecology, entomology, food science and technology, microbiology, nutritional science, zoology, or veterinary medicine. Minimum undergraduate coursework should include the following or their equivalent: 1 year of college mathematics, including calculus; 1 year of inorganic chemistry with quantitative analysis; 1 course in physics; 1 year of organic chemistry; 2 years of biological sciences including 1 course in physiology.

Other courses that are considered desirable in the undergraduate preparation include: biochemistry, physical chemistry, qualitative analysis, and some specialized courses such as histology or advanced physiology. Prospective students not meeting these requirements may be admitted on a provisional

basis with approval of the admissions committee and the program of study committee.

Facilities and faculty are available in these departments for fundamental research in such areas as aquatic toxicology, environmental fate and effects of chemicals, food safety, neurotoxicology, nutritional toxicology, pesticides, and veterinary toxicology.

Students majoring in toxicology will be affiliated with a cooperating department and choose a major professor from the participating faculty in that department. All Ph.D. students take a core curriculum consisting of Tox 501 and 502, 2 credits of Tox 500 (Toxicology Seminar), 7 additional credits in toxicology, 8 credits in biochemistry (from BBMB 404, 405, 420, 451, 521), 3 graduate credits in physiology, histology, or pathology; Stat 401 and 402. M.S. students take a core of Toxicology 501 and 502, 1 credit of Toxicology 500 Seminar, 3 additional credits in toxicology, BBMB 404 and 405, Stat 401. Additional coursework is selected to meet departmental requirements and to satisfy individual student research interests; toxicology courses may be chosen from those listed below. The foreign language requirement is determined by the student's major department.

Graduates of the Toxicology major will be able to carefully design, execute and analyze experiments that extend the knowledge of toxicology and closely related sciences. They will be able to clearly communicate research findings, and thoroughly evaluate the literature of toxicology, contributing significantly to the advancement of the field.

A graduate minor in toxicology is available for students enrolled in other majors. A minor for an M.S. degree includes Tox 500 and 501 and 6 credits in other toxicology courses. A minor at the Ph.D. level includes Tox 500, 501, and 9 credits in other toxicology course work. One member of the student's program of study committee will be a member of the toxicology faculty.

Courses open for nonmajor graduate credit: 419, 420.

Courses Primarily for Undergraduate Students

Tox 419. Foodborne Hazards. (Same as FS HN 419.) See *Food Science and Human Nutrition*. Nonmajor graduate credit.

Tox 420. Food Microbiology. (Same as Micro 420.) See *Microbiology*. Nonmajor graduate credit.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Tox 500. Toxicology Seminar. (Same as V Pth 500.) (1-0) Cr. 1 each time taken. F.S. Prereq: *Permission of instructor*. Presentation of a seminar about a current topic in toxicology as part of a weekly series of seminars by graduate students, faculty, and guest lecturers from off campus.

Tox 501. Principles of Toxicology. (Same as V Pth 501, Zool 501.) (3-0) Cr. 3. S. Prereq: *BBMB 404 or equivalent*. Principles of toxicology governing entry, fate, and effects of toxicants on living systems. Includes toxicokinetics and foreign compound metabolism relative to toxification or detoxification. Fundamentals of foreign compound effects on metabolism, physiology, and morphology of different cell types, tissues, and organ systems.

Tox 502. Toxicology Methods. (Same as V Pth 502, Zool 502.) (0-6) Cr. 3. Alt. F., offered 1999. Prereq: *501*. Provides demonstrations or laboratory experience in the application of methods used in toxicology, including safety procedures, calculation and data analysis, teratologic and morphologic evaluation, electrophysiologic measures, in vitro enzyme induction/biotransformation, neural and behavioral toxicology testing.

Tox 513. Ecological Toxicology. (Same as A Ecl 513.) See *Animal Ecology*.

Tox 519. Food Toxicology. (Same as FS HN 519.) See *Food Science and Human Nutrition*.

Tox 526. Veterinary Toxicology. (Same as V Pth 526.) (3-0) Cr. 3. S. Prereq: *Graduate classification and V Pth 542*. A study of disease processes in animals caused by toxicants and the use of differential diagnostic and therapeutic procedures.

Tox 535. Biological Statistics. (Same as Stat 535.) See *Statistics*.

Tox 544. Aquatic Toxicology. (Same as A Ecl 544.) See *Animal Ecology*.

Tox 546. Clinical and Diagnostic Toxicology. (Same as V Path 546.) (0-3 to 0-9) Cr. 1 to 3 each time taken. Prereq: *V Pth 526 or DVM degree*. Advanced study of current problems and issues in toxicology. Emphasis on problem solving utilizing clinical, epidemiological, and laboratory resources.

Tox 550. Pesticides in the Environment. (Same as Ent 550.) See *Entomology*.

Tox 554. General Pharmacology. (Same as B M S 554.) See *Biomedical Sciences*.

Tox 555. Neurobehavioral Toxicology. (Same as V Pth 555.) (3-0) Cr. 3. Alt. F., offered 1999. Prereq: *V Pth 501*. Advanced study of neurotoxicology and behavior. Emphasis on methods in neurobehavioral toxicology and the effects of a broad spectrum of neurotoxic agents.

Tox 590. Special Topics.

Courses for Graduate Students

Tox 626. Advanced Food Microbiology (Same as FS HN 626.) See *Food Science and Human Nutrition*.

Tox 643. Natural Toxins. (Same as V Pth 643.) (1-6) Cr. 3. Alt. F., offered 2000. Prereq: *Courses in biochemistry and physiology*. Naturally occurring toxins in foods and feeds, poisonous plants and venoms. .

Tox 645. Agricultural and Environmental Analytical Toxicology. (Same as V Pth 645.) (1-3) Cr. 2. F. Prereq: *Chem 211, 322*, Analysis and interpretation of toxicant residues in animal tissues, foods, water, soil, and other environmental specimens.

Tox 675. Insecticide Toxicology. (Same as Ent 675.) (2-3) Cr. 3. Alt. F., offered 2000. Prereq: *Ent 555 or Tox 501*. Coats. Principles of insecticide toxicology; classification, mode of action, metabolism, and environmental effects of insecticides.

Tox 699. Research.

ronmental and social policy analysis of transportation systems, transportation policy analysis, analysis of transportation technologies, commodity distribution, public administration of the transportation planning process, regional development and transportation system interrelationships, transportation economics and finance, and planning for logistics management.

Students majoring in transportation will choose a major professor from the graduate faculty membership of the cooperating departments and will develop a program of study under the guidance of a committee nominated by the administrative department head, approved by the departmental transportation supervisory committee representative, and appointed by the dean of the Graduate College. For administrative purposes, students will be in the departments of their major professors.

A student must complete at least 36 credit hours of acceptable work including preparation of a thesis. A structured minor requires 12 credits of approved transportation courses and a thesis on a transportation related topic.

A required core includes C E 551, Trans 691, and at least one course from two different cooperating departmental offerings included among the following courses: C E 558; C R P 522; TrLog 560. Detailed requirements are available from the chair of the supervisory committee.

Graduate students pursuing a major in any of the cooperating departments who have an interest in transportation are encouraged to consider a formal declared minor in transportation. Students considering a declared minor should consult with the chair of the supervisory committee about the requirements for it.

Students typically focus their program of study to support a career in one of four areas: regional and statewide transportation planning, transportation service operations and transportation management, transportation policy and economic analysis, and transportation planning and operation for local and state governments. Graduates will have specific knowledge in one or more of these focus areas and the skills to conduct research and analysis of transportation issues. These skills allow graduates to be productive immediately in positions related to a focus area or to continue in more advanced transportation graduate work.

Courses Primarily for Graduate Students

Trans 555. Economic Analysis of Transportation Investments. (3-0) Cr. 3. Alt. S., offered 2000. Prereq: *C E 350 or 352*. Application of economic analysis methodologies to evaluate transportation projects. Multi-modal approaches to evaluate impacts of transportation investments and maximize economic efficiency while considering equity and other social issues related to investment options.

Trans 691. Seminar in Transportation Planning. Cr. 1 to 3. S.S. Provide an overview of current transportation issues; lecturers provide seminars of a variety of timely transportation topics.

Trans 699. Research.

Transportation

(Interdepartmental Graduate Major)

Supervisory Committee: T. Maze, Chair; M. R. Crum, R. G. Mayayni

Work is offered for the degree master of science (thesis option only) with a major in transportation under a cooperative arrangement with various departments including Civil and Construction Engineering, Community and Regional Planning, and Logistics, Operations and Management Information Systems. Opportunities are afforded for research in such areas as modeling and performance of transportation systems, techniques for urban and regional transportation system planning, envi-

Transportation and Logistics

(Administered by the Department of Logistics, Operations and Management Information Systems)

Michael R. Crum, Chair of Department

Distinguished Professors: Allen, Baumel

Professors: Crum, Poist, Wacker

Professors (Emeritus): Thompson, Voorhees

Associate Professors: Chu, Nilakanta, Norris, Premkumar, Walter

Assistant Professors: Goldsby, Hendrickson, Johnson, Strader, Suzuki, Zhu

Instructors (Adjunct): Blanshan, Choobineh

Undergraduate Study

For the undergraduate curriculum in business, major in transportation and logistics, see *College of Business, Curricula*.

Transportation and logistics management is a discipline concerned with the efficient flow of materials through our industrial and economic system. Transportation management deals with the management of the domestic and international modes of transportation in today's rapidly changing economic environment. Logistics management assumes the systems approach to the management of a wide variety of activities such as inventory control, warehousing, traffic management, location analysis, packaging, materials handling, and customer service.

The study of transportation and logistics serves as a specialized program for those who plan careers in transportation or logistics with shippers, carriers, and government agencies. It is a broad-based educational program which emphasizes the managerial aspects of transportation and logistics systems and concepts.

The requirements for the transportation and logistics major are met by completion of the following courses: TrLog 460, 461, plus a choice of three of the following: TrLog 462, 463, 466, 468, or 469. In addition, one course will be selected from the following: TrLog 462, 463, 466, 468, 469, 490, Acct 316, 383, Fin 352, Mgmt 418, 419, or Mkt 343.

Graduate Study

The department participates in two graduate degree programs: the M.S. in Business Administrative Sciences and the M.B.A. full-time day and part-time weekend programs. The M.S. degree in Business Administrative Sciences is a 30-credit curriculum culminating in a thesis. The M.B.A. program is a 48-credit, nonthesis, noncreative component curriculum. Twenty four of the 48 credit hours are core courses and the remaining 24 are graduate electives. The department also participates in the interdepartmental transportation major.

Fully-admitted M.B.A. degree candidates with previous business study as an undergraduate may qualify for advanced entry into the M.B.A. program. Advanced entry is designed to serve

those students with a bachelor's degree in business as they may complete the M.B.A. degree program requirements in as few as 30 semester credit hours. Information about the advanced M.B.A. entry applications process can be obtained in the College of Business Graduate Programs Office, 218 Carver Hall.

Courses open for nonmajor graduate credit: 461, 462, 463, 466, 468, and 469.

Courses Primarily for Undergraduate Students

TrLog 360. Business Logistics. (3-0) Cr. 3. *Prereq:* Econ 101. Introduction and analysis of the logistics concept to include the management of transportation, inventory, packaging, warehousing, materials handling, order processing, facility location, and customer service.

TrLog 460. Advanced Logistics Management. (3-0) Cr. 3. *Prereq:* 360 and Stat 227. Development of logistics topics introduced in 360. Emphasis on managing inbound and outbound flows of products and associated information requirements in the logistics system.

TrLog 461. Transport Economics. (3-0) Cr. 3. *Prereq:* Stat 227, Econ 101. The role of transportation in the economy. The economic characteristics of the various modes of transportation, including the nature of transport demand and cost functions; economic dimensions of transport service; transport market structures; and transport pricing theory and practice. Emphasis on managerial implications of transport economic principles. Nonmajor graduate credit.

TrLog 462. Transportation Carrier Management. (3-0) Cr. 3. *Prereq:* Credit or enrollment in 461. Analysis of transport users' requirements. Carrier management problems involving ownership and mergers, routes, competition, labor, and other decision areas. Nonmajor graduate credit.

TrLog 463. Industrial Purchasing. (3-0) Cr. 3. *Prereq:* 360. Principles and policies in acquiring goods and services for the firm. Emphasis on purchasing as it relates to materials management. Nonmajor graduate credit.

TrLog 466. International Transportation and Logistics. (3-0) Cr. 3. *Prereq:* 360. Logistics systems and legal framework for the international movement of goods. Operational characteristics of providers of exporting and importing services. The effects of government trade policies on global logistics. Nonmajor graduate credit.

TrLog 468. Transportation and Public Policy. (3-0) Cr. 3. *Prereq:* Credit or enrollment in 461. Analysis of current policies affecting transportation providers and users. The roles of carrier and shipper organizations, government agencies, and other interest groups in policy development. Evaluation of impact of programs, policies, and legislation on various transportation constituencies. Nonmajor graduate credit.

TrLog 469. Transportation and Logistics Issues. (3-0) Cr. 3. *Prereq:* 460, 461. An integrative course designed to study contemporary problems and issues in transportation and logistics. Nonmajor graduate credit.

TrLog 490. Independent Study. Cr. 1-3 each time taken. *Prereq:* 360, senior classification, permission of instructor.

Courses Primarily for Graduate Students

TrLog 560. Business Logistics Strategies. (3-0) Cr. 3. *Prereq:* Graduate classification. Management of the logistics functions in the firm, including transportation, inventory control, warehousing, packaging, facility location, materials handling, and customer service. Includes both theoretical aspects and practical applications in logistics.

TrLog 561. Transportation Management and Policy. (3-0) Cr. 3. *Prereq:* Graduate classification. Analysis of contemporary issues and strategies in transportation management and policy. Emphasis on evaluation of the impacts of transportation policies,

new technologies, and strategic carrier and shipper management practices on the freight transportation industry and logistics systems.

TrLog 590. Special Topics. Cr. 1 to 5 each time taken. *Prereq:* Graduate classification and permission of instructor. For students who wish to do individual research in a particular area of transportation or logistics.

University Studies

Howard Shapiro, Vice Provost for Undergraduate Programs

Certain interdisciplinary courses are offered through university studies, at the discretion of the vice provost for undergraduate programs and the Faculty Senate Curriculum Committee. No major is available in university studies, but credit obtained through university studies offerings may be applied toward a degree in any of the colleges, consistent with the stipulations of the student's curriculum.

Requests to make use of U St 101, 290, 301, and 490 should be directed to the vice provost for undergraduate programs and should be accompanied by a positive recommendation from the department heads and deans of the instructors making the request. The Faculty Senate Curriculum Committee will consider all requests and recommend to the vice provost for undergraduate programs regarding their disposition after consultation with appropriate college and university committees.

The Graduate College sponsors U St 180 and 511 to help graduate students carry out instructional tasks as teaching assistants. Placement in 180 is determined by examination (SPEAK/TEACH tests).

Courses open for nonmajor graduate credit: 342.

Courses Primarily for Undergraduate Students

U St 101. Interdisciplinary Studies. Cr. var. Yr. Offered when demand warrants. Experimental interdisciplinary courses offered by an interdepartmental group. Intended primarily for freshman and sophomore offerings.

U St 111. Hixson Scholars Seminar. (1-0) Cr. 1. F. *Prereq:* Recipient of the Hixson Opportunity Award. Orientation to Iowa State University and the Hixson Opportunity Awards Program. Offered on a satisfactory-fail grading basis only.

U St 120. Study Abroad Credit. (Same as IntSt 120.) See *International Studies*.

U St 131, 132. Early Success Seminar. (0-2) Cr. 1. F.S. Orientation to the university for students in the Early Success Program. Offered on a satisfactory-fail grading basis only.

U St 180. Communication Skills for International Teaching Assistants. (Same as Engl 180.) F.S. Placement based upon SPEAK/TEACH test results. Persons whose native language is English cannot take 180 for credit. No more than one section of 180 may be taken per semester; up to two sections total. Credit does not apply toward graduation. Offered on a satisfactory-fail grading basis only.

A. Speaking Skills. Cr. 3. Emphasis on pronunciation improvement and greater fluency in spoken English for teaching purposes.

B. Intermediate Spoken English. Cr. 3. Interactive speaking and response to questions is emphasized.

C. Advanced Spoken English. Cr. 3. For students who have completed 180A or 180B but have not reached the passing level on the SPEAK/TEACH test.

D. Presentation Skills. Cr. 3. Developing explanations, leading discussions and handling questions in a teaching environment.

E. Supervised Independent Study. Cr. 1. Seminar with individual observation and consultation.

U St 220. Study Abroad Credit. (Same as IntSt 220.) See *International Studies*.

U St 221. Academic Excellence Workshop for Physics 221. (0-3) Cr. 1. F.S. *Prereq:* Concurrent enrollment in Phys 221, and permission of instructor. Collaborative learning community workshop to accompany Physics 221. Offered on a satisfactory-fail grading basis only.

U St 222. Academic Excellence Workshop for Physics 222. (0-3) Cr. 1. F.S. *Prereq:* Concurrent enrollment in Phys 222, and permission of instructor. Collaborative learning community workshop to accompany Phys 222. Offered on a satisfactory-fail grading basis only.

U St 235. Introduction to International Studies. (Same as IntSt 235.) See *International Studies*.

U St 290. Special Problems. Cr. var. *Prereq:* Permission of the provost. Independent study on topics of an interdisciplinary nature. Intended primarily for freshmen and sophomores.

U St 298. Federal Cooperative Education Program. Cr. R. F.S.SS. *Prereq:* Permission of director, ISU Career Planning and Placement Services; sophomore classification. Required of all Federal Cooperative Education students. Students must register for this course prior to commencing each work period with the Federal Government.

U St 301. Interdisciplinary Studies. Cr. var. Yr. Offered when demand warrants. Experimental interdisciplinary courses offered by an interdepartmental group. Intended primarily for junior and senior offerings.

U St 320. Study Abroad Credit. (Same as IntSt 320.) See *International Studies*.

U St 342. World Food Issues: Past and Present. (Same as Agron 342.) See *Agronomy*. Nonmajor graduate credit.

U St 385. The Holocaust. (2-0) Cr. 2 or (3-0) Cr.3. F. An examination of the religious, social, scientific, and historical contexts for the Nazi destruction of European Jewry. Topics covered include anti-Semitism, German volkish philosophy, eugenics, World War II, the Final Solution, rescuers, and contemporary issues. Optional third credit requires a term paper.

U St 398. Federal Cooperative Education Program. Cr. R. F.S.SS. *Prereq:* Permission of director, ISU Career Planning and Placement Services; junior classification. Required of all Federal Cooperative Education students. Students must register for this course prior to commencing each work period with the Federal Government.

U St 420. Study Abroad Credit. (Same as IntSt 420.) See *International Studies*.

U St 430. Seminar in International Studies. (Same as IntSt 430.) See *International Studies*.

U St 490. Independent Study. Cr. var. *Prereq:* Permission of the provost. Independent study on topics of an interdisciplinary nature. Intended primarily for juniors and seniors.

I. International Studies

U St 498. Federal Cooperative Education Program. Cr. R. F.S.SS. *Prereq:* Permission of director, ISU Career Planning and Placement Services; senior classification. Required of all Federal Cooperative Education students. Students must register for this course prior to commencing each work period with the Federal Government.

Courses Primarily for Graduate Students, Open To Qualified Undergraduate Students

U St 511. Teaching Assistants' Orientation Seminar (TAOS). (0-2) Cr. 1. F.S. *Prereq:* Graduate classification. Survey of basic techniques of college teaching for graduate teaching assistants who have

no background in teaching. Videotaped micro-teaching experiences: methods of lecturing, conducting discussion, questioning, and reinforcement; simple media production and classroom testing and evaluation.

U St 541. Technological Innovation, Social Change, and Development. (Same as Soc 541.) See *Sociology*.

U St 542. World Food Issues. (Same as T SC 542.) See *Technology and Social Change*.

U St 543. Development Advisory Team (DAT) Training Workshop. (Same as Anthr 543.) See *Anthropology*.

U St 590. Special Topics. Independent study on topics of an interdisciplinary nature. Intended primarily for graduate students.

F. Technology and Social Change. (Same as T SC 590F.)

Courses for Graduate Students

U St 640. Seminar in Technology and Social Change. (Same as T SC 640.) See *Technology and Social Change*.

U St 641. Implementing International Agriculture and Rural Development Projects: Problems and Issues. (Same as Anthr 641.) See *Anthropology*.

Veterinary Clinical Sciences

Christopher M. Brown, Chair of Department

Professors: Betts, Brown, Evans, Grier, Hoefle, Hopkins, Jackson, Merkley, Noxon, D. Riedesel

Professors (Emeritus): Carithers, Clark, Emmerson, Eness, Lundvall, Pearson

Associate Professors: Baldwin, Booth, Jergens, Miles, Nieves, Obrien, Reinertson, E. Riedesel, Wagner, Ware

Assistant Professors: Conzemius, Graham, Hopper, Kline

Instructors (Adjunct): Corti, Goldman, Little, Morse, Ridgway, Schreiner, Sponseller, Swainson, Walesby, Welch

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see *Veterinary Medicine, Curriculum*.

The study of medicine and surgery expands the training previously received in anatomy, physiology, pharmacology, pathology, and microbiology.

The department presents coursework in animal reproduction concerning interferences with parturition, diseases of the newborn, and infertility.

The teaching of radiology emphasizes the production and interpretation of radiographs and the dangers of ionizing radiation to humans and animals. Alternate imaging modalities, including ultrasonography and nuclear medicine are also taught.

Hospital assignments during the fourth year provide the student an opportunity to participate in the application of clinical skills and knowledge.

Graduate Study

The department offers work for the degree master of science with major in veterinary clinical science, and minor work for students majoring in other departments. Within the veterinary clinical sciences major, the student may specialize in veterinary medicine, swine production medicine, surgery, or theriogenology. The D.V.M. degree or equivalent is prerequisite to a major graduate work.

Both thesis and nonthesis options are available and require the completion of a minimum of 30 graduate credits and a final examination.

Foreign language requirements may be established by the student's program of study committee.

Courses Primarily for Undergraduate Students

V C S 385. Seminar. (Same as VDPAM 385.) (1-0) Cr. R each time taken. F.S. *Prereq:* Classification in veterinary medicine. Seminars and case discussions on selected clinical subjects by staff and fourth-year students of the College of Veterinary Medicine. Offered on a satisfactory-fail grading basis only.

V C S 391. Radiology. (2-0) Cr. 1. S. 8 weeks. *Prereq:* First-year classification in veterinary medicine. Essentials of radiology and radiobiology with special emphasis on radiation safety. Introduction to diagnostic imaging methods, image interpretation, and radiation therapy.

V C S 397. Principles of Surgery (Same as VDPAM 397.) (6-0) Cr. 6. S. *Prereq:* Second-year classification in veterinary medicine. General principles of surgery of domestic animals.

V C S 398. Anesthesiology. (1-0) Cr. 1. S. *Prereq:* Second-year classification in veterinary medicine. Anesthetic equipment, agents, and procedures for domestic animals.

V C S 399. Ophthalmology. (1-0) Cr. 1. S. *Prereq:* Third year classification in veterinary medicine. Principles and techniques of medical and surgical ophthalmology.

V C S 401. Advanced Small Animal Orthopedics. (1-0) Cr. 1. S. *Prereq:* Third-year classification in veterinary medicine. Elective course in advanced small animal orthopedics.

V C S 402. Electrocardiology. (1-0) Cr. 1. S. *Prereq:* Third-year classification in veterinary medicine. Elective course in electrocardiology.

V C S 405. Introduction to Pet Birds. (1-0) Cr. 1. F. *Prereq:* Third-year classification in veterinary medicine. Elective course in management and diseases in pet birds.

V C S 407. Feline Internal Medicine. (1-0) Cr. 1. F. *Prereq:* Third-year classification in veterinary medicine. Elective course in feline internal medicine.

V C S 408. Small Animal Clinical Oncology. (2-0) Cr. 2. S. *Prereq:* Third or fourth year classification in veterinary medicine. Principles and practice of small animal oncology. Diagnosis, treatment, and management of veterinary cancer patients.

V C S 414. Companion Animal Nutrition. (1-0) Cr. 1. S. *Prereq:* Third-year classification in veterinary medicine. Elective course in small animal and equine nutrition.

V C S 415. Advanced Small Animal Dermatology. (1-0) Cr. 1. S. *Prereq:* Third-year classification in veterinary medicine. Elective course in dermatology.

V C S 419. Preceptorship in Veterinary Medical Practice. Cr. 1 to 6 each time taken. F.S.SS. *Prereq:* Fourth-year classification in veterinary medicine, permission of department chair. Elective course in veterinary practice under the guidance of veterinarians in approved practice settings.

V C S 420. **Animal Welfare.** (2-0) Cr. 1. Alt. F., offered 1999, first 8 weeks. Guest speakers discuss topics pertaining to animal welfare.

V C S 421. **Biology and Diseases of Rodents and Rabbits** (2-0) Cr. 1. S. 8 weeks. *Prereq:* *Second-, third-, or fourth-year classification in veterinary medicine.* Husbandry, management, and common diseases of rabbits, guinea pigs, hamsters, gerbils, rats, and mice.

V C S 440. **Introduction to Clinics.** (Same as VDPAM 440.) (0-4) Cr. R. F. 8 weeks. *Prereq:* *Third-year classification in veterinary medicine.*

V C S 443. **Equine Lameness.** (1-0) Cr. 1. F. S. *Prereq:* *Third-year classification in veterinary medicine.* Orthopedic diseases of the equine.

V C S 444. **Clinical Medicine I.** (5-0) Cr. 5. F. *Prereq:* *Third-year classification in veterinary medicine.* Clinical diagnostic methods and consideration of diseases of domestic animals.

V C S 445. **Clinical Medicine II.** (Same as VDPAM 445.) (5-0) Cr. 5. S. *Prereq:* *Third-year classification in veterinary medicine.* Clinical diagnosis and treatment of diseases of equine, swine, beef, dairy, and sheep.

V C S 446. **Clinical Neurology.** (0-40) Cr. 2. *Prereq:* *Fourth-year classification in veterinary medicine.* Forty hour per week. Clinical rotation in neurology with an emphasis on neurolocalization, disease processes, use of diagnostics in medical and surgical neurology and treatment options. Exposure to neurosurgical techniques.

V C S 448. **Radiology.** (2-0) Cr. 2. S. *Prereq:* *Third-year classification in veterinary medicine.* Essentials of diagnostic imaging and radiobiology with emphasis on diagnostic interpretation and protection from radiation.

V C S 449. **Surgery Laboratory.** (1-4) Cr. 3. F. *Prereq:* *Third-year classification in veterinary medicine.*

V C S 450. **Disturbances of Reproduction.** (Same as VDPAM 450.) (4-0) Cr. 4. F. *Prereq:* *Third-year classification in veterinary medicine.* General principles of diseases causing disturbances in reproduction.

V C S 451. **Advanced Small Animal Soft Tissue Surgical Laboratory.** (1-6) Cr. 2. *Prereq:* *VCS 397, 398, 399, 449.* Advanced small animal soft tissue surgical procedures involving the abdominal cavity. Less emphasis will be placed on the thoracic cavity and head and neck injury.

V C S 452. **Clinical Dermatology.** Cr. 2. *Prereq:* *Fourth-year classification in veterinary medicine, small animal option.* Study of clinical dermatological problems via computer-aided instruction, case simulations, and/or lectures. Clinical management of cases presented to Veterinary Teaching Hospital.

V C S 453. **Small Animal Medicine I.** Cr. 2 each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Clinical assignment in small animal medicine.

V C S 454. **Small Animal Medicine II.** Cr. 2 each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Clinical assignment in small animal medicine.

V C S 455. **Small Animal Soft Tissue Surgery.** Cr. 2 each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Clinical assignment in soft tissue surgery.

V C S 456. **Small Animal Orthopedic Surgery.** Cr. 2 each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Clinical assignment in orthopedic surgery.

V C S 457. **Equine Medicine.** Cr. 3 each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Clinical assignment in equine medicine.

V C S 458. **Equine Surgery.** Cr. 3 each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Clinical assignment in equine surgery.

V C S 460. **Radiology.** Cr. 3. *Prereq:* *Fourth-year classification in veterinary medicine.* Clinical assignment in veterinary radiology.

V C S 463. **Community Practice.** (0-40) Cr. 2 each time taken. *Prereq:* *Fourth year classification in veterinary medicine.* Forty hours per week. Clinical experience in hospital based general practice.

V C S 466. **Anesthesiology.** Cr. 3. *Prereq:* *Fourth-year classification in veterinary medicine.* Clinical assignment in small animal and large animal anesthesiology.

V C S 468. **Intensive Care.** Cr. 4. *Prereq:* *Fourth-year classification in veterinary medicine.* Clinical assignment to provide supervision of hospital cases requiring intensive care and including emergency cases.

V C S 469. **Special Senses.** Cr. 2 each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Clinical assignment in ophthalmology.

V C S 470. **Radiology.** Cr. var each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Elective clinical assignment in veterinary radiology.

V C S 471. **Animal Reproduction.** Cr. var each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Elective clinical assignment in animal reproduction. Equine and small animal reproduction only.

V C S 472. **Small Animal Medicine.** Cr. var each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Elective clinical assignment in small animal medicine.

V C S 473. **Small Animal Surgery.** Cr. var each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Elective clinical assignment in small animal surgery.

V C S 474. **Equine Medicine and Surgery.** Cr. var each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Elective clinical assignment in equine medicine and surgery.

V C S 476. **Anesthesiology.** Cr. var each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Elective clinical assignment in small animal and large animal anesthesiology.

V C S 478. **Intensive Care.** Cr. var each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Elective clinical assignment in intensive care.

V C S 479. **Special Senses.** Cr. var each time taken. *Prereq:* *Fourth-year classification in veterinary medicine.* Elective clinical assignment in ophthalmology.

V C S 480. **Veterinary Dentistry.** Cr. 1. F. *Prereq:* *Fourth-year classification in veterinary medicine.* All aspects of veterinary dentistry, prophylaxis, endodontics, and orthodontics.

V C S 484. **Advanced Pet Bird Medicine.** (1-0) Cr. 1. F., every other year. Elective course emphasizing diagnostic and therapeutic techniques and infectious and non-infectious disease in pet birds.

V C S 490. **Independent Study.** Cr. 1 to 5. *Prereq:* *Permission of instructor and department chair.*

V C S 495. **Seminar.** (Same as VDPAM 495.) Cr. R. S. *Prereq:* *Fourth-year classification in veterinary medicine.* Seminars and case discussions on selected subjects by staff of the College of Veterinary Medicine and others, including student presentations. Offered on a satisfactory-fail grading basis only.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

V C S 590. **Special Topics.** Cr. 1 to 3. *Prereq:* *Permission of instructor.*

- A. Medicine
- B. Surgery
- C. Theriogenology
- D. Radiology
- E. Anesthesiology

V C S 599. **Creative Component.** Cr. var. *Prereq:* *Enrollment in nonthesis master's degree program.*

Courses for Graduate Students

V C S 604. **Seminar.** Cr. 1 each time taken. F. S.

V C S 640. **Advanced Radiology.** (2-0) Cr. 2. Alt. F., offered 1999. *Prereq:* 448. Detailed principles of clinical

radiology with particular reference to radiographic interpretation.

V C S 644. **Advanced Animal Reproduction.** (1-3) Cr. 2. Alt. S., offered 2000. *Prereq:* 447, 450. A detailed study of reproductive diseases of the male animal.

V C S 645. **Advanced Animal Reproduction.** (1-3) Cr. 2. Alt. S., offered 2001. *Prereq:* 447, 450. A detailed study of reproductive diseases of the female animal.

V C S 671. **Advanced General Surgery.** (1-3) Cr. 2. Alt. S., offered 2000. *Prereq:* 441. An advanced course designed to investigate and discuss the responses of the body to surgical and anesthetic procedures.

V C S 672. **Advanced Special Surgery.** (1-3) Cr. 2. Alt. S., offered 2001. *Prereq:* 449. Advanced procedures in both clinical and research techniques in abdominal, thoracic, orthopedic, cardiovascular, and neurological surgery.

V C S 676. **Advanced Medicine.** (2-0) Cr. 2. Alt. F., offered 1999. *Prereq:* 445. Principles of general medicine. A study in depth of factors that contribute to the development of clinical signs as related to the pathogenesis of disease.

V C S 677. **Advanced Medicine.** (2-0) Cr. 2. Alt. F., offered 2000. *Prereq:* 445. An advanced study of metabolic diseases.

V C S 699. **Research.**

- A. Medicine
- B. Surgery
- C. Theriogenology
- E. Anesthesiology

Veterinary Diagnostic and Production Animal Medicine

Nolan R. Hartwig, Chair of Department

Professors: Carson, Evans, Harris, Hartwig, Hoffman, Hopkins, Hopper, Hyde, Kunesh, McKean, Osweiler, Thomson, Trampel, Wass

Associate Professors: Halbur, Janke, Kersting, Larson, Thacker, Thompson, Uhlenhopp, Yaeger, Zimmerman

Assistant Professors: Apley, Holtkamp, Sorden, Yoon

Assistant Professors (Adjunct): Harmon, Imerman, Kozak, Schwartz

Instructors (Adjunct): Boettcher, D. Ensley, S. Ensley, Fajt, Harms, Kinyon, Nutsch, Pence, Robbe

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see *Veterinary Medicine, Curriculum.*

The study of veterinary diagnostic and production animal medicine provides the student with basic and advanced skills in diagnostics, reproduction, medicine, surgery, production, and health management of the major livestock species. Students in the fourth year of the curriculum in veterinary medicine may elect to take advanced courses in beef, dairy, swine, or sheep production medicine. Elective courses may include preceptorships in private prac-

tices, other veterinary schools, research and disease control laboratories.

Production animal medicine emphasizes the integration of veterinary science with nutrition, genetics, economics, and other disciplines, enabling graduates to use a broad knowledge base to support the health and production of food and fiber animals.

Graduate Study

The department offers graduate courses for students pursuing graduate work in other departments. The D.V.M. degree or equivalent is prerequisite to enrollment in these courses.

Courses Primarily for Undergraduate Students

VDPAM 385. Seminar. (Same as V C S 385.) (1-0) Cr. R each time taken. F.S. *Prereq:* *Classification in veterinary medicine.* Seminars and case discussions on selected clinical subjects by staff and fourth-year students of the College of Veterinary Medicine. Offered on a satisfactory-fail grading basis only.

VDPAM 397. Principles of Surgery. (Same as V C S 397.) (6-0) Cr. 6. S. *Prereq:* *Second year classification in veterinary medicine.* General principles of surgery of domestic animals.

VDPAM 411. Production Animal Medicine. Cr. 4 each time taken. F.S.SS. *Prereq:* *VM IV classification.* Seasonal enrollment limit. Clinical assignment in food animal production medicine and service. Emphasis on diagnosis, medicine, surgery, theriogenology, and treatment skills.

VDPAM 416. Bovine Reproduction Evaluation Laboratory. (0-3) Cr. 1. F.S. *Prereq:* *Third year classification in veterinary medicine.* 10 students per section. Bovine rectal palpation techniques will be repetitively taught in three-hour sessions. Students will learn techniques of epidural anesthesia, artificial insemination, and ultrasonic imaging. University-owned cattle will be used.

VDPAM 420. Preceptorship in Veterinary Medical Practice. Cr. 1 to 6 each time taken. F.S.SS. *Prereq:* *Fourth-year classification in veterinary medicine, permission of department chair.* Elective course in veterinary practice under the guidance of veterinarians in approved practice settings.

VDPAM 426. Veterinary Toxicology. (Dual-listed with 526, same as V Pth 426.) Cr. 3. S. *Prereq:* *Third-year classification in veterinary medicine.* A study of the disease processes in animals caused by toxicants and the use of differential diagnostic and therapeutic procedures.

VDPAM 437. Investigational Techniques in Dairy Production Medicine: Dairy Herd Problem Identification. (7-33) Cr. 2. F.S.SS. *Prereq:* *Fourth-year classification in veterinary medicine.* Seven hours recitation/discussion and 33 hours clinical experience per week. Course taken for two weeks at University of Wisconsin, Madison on a space-available basis. Identify equipment, facilities and management characteristics of dairy farms. Understand dairy herd records and use to examine health and productivity. Prioritize herd health and production problems and evaluate adequacy of ventilation and housing systems.

VDPAM 438. Milk Quality in Dairy Production Medicine: Mastitis/Milk Quality. (9-31) Cr. 2. F.S.SS. *Prereq:* *Fourth-year classification in veterinary medicine.* Nine hours recitation/discussion and 31 hours clinical experience per week. Course taken for two weeks at University of Wisconsin, Madison on a space-available basis. Analysis of somatic cell counts. Bulk tank milk cultures, individual cow microbiology. Milking system analysis and milking management. Evaluate milking practices, assess dairy environment and partial budget techniques.

VDPAM 439. Nutrition in Dairy Production Medicine: Applied Dairy Nutrition. (3-37) Cr. 2. F.S.SS. *Prereq:* *Fourth-year classification in veterinary*

medicine. Three hours lecture, 37 hours clinical experience per week. Course taken for two weeks at University of Wisconsin, Madison on a space-available basis. Production and metabolic disease problems. Evaluate feeding management. Forage and feedstuff analysis, dry matter determinations. Ration analysis using trilogic computer programs.

VDPAM 440. Introduction to Clinics. (Same as V C S 440.) (0-4) Cr. R. F. 8 weeks. *Prereq:* *Third-year classification in veterinary medicine.*

VDPAM 445. Clinical Medicine. (Same as V C S 445.) (5-0) Cr. 5. S. *Prereq:* *Third year classification in veterinary medicine.* Clinical diagnosis and treatment of diseases of equine, swine, beef, dairy, and sheep.

VDPAM 450. Disturbances of Reproduction. (Same as V C S 450.) (4-0) Cr. 4. F. *Prereq:* *Third-year classification in veterinary medicine.* General principles of diseases causing disturbance in reproduction.

VDPAM 455. Diagnostic Laboratory Practicum. Cr. 2 each time taken. F.S.SS. *Prereq:* *Fourth-year classification in veterinary medicine.* Practical experience in diagnosis of field cases.

VDPAM 471. Food Animal Reproduction. Cr. var. F.S.SS. Seasonal enrollment limit. Clinical elective in animal reproduction of livestock species.

VDPAM 477. Food Animal Medicine and Surgery. Cr. var. each time taken. Seasonal enrollment. *Prereq:* *Fourth-year classification in veterinary medicine.* Elective clinical assignment in food animal medicine and surgery.

VDPAM 478. Introduction to Swine Production Medicine. (15-20) Cr. 2. F.S.SS. *Prereq:* *Fourth-year classification in veterinary medicine.* Two week introductory topics in swine production medicine with emphasis on monitoring disease, disease prevention, and production economics. Fifteen hours recitation/discussion and 20 hours clinical experience per week.

VDPAM 479. Swine Production Medicine Preceptorship. (0-40) Cr. 1-6 each time taken. F.S.SS. *Prereq:* 478. Two week advanced course in swine production medicine with emphasis on herd management, production analysis, and problem solving. Forty hours clinical experience per week. Assignments will include preceptorships with a practicing veterinarian and/or a production unit.

VDPAM 480. Advanced Swine Production Medicine. (15-20) Cr. 2. F.S.SS. *Prereq:* 478. Two week advanced clinical rotation in swine production medicine. Fifteen hours recitation/discussion and 20 hours clinical experience per week. The instructor will lead field trips as well as problem solving exercises where the student will apply concepts of herd management, production analysis, and disease prevention.

VDPAM 481. Introduction to Beef Production Medicine. (15-20) Cr. 2. SS. *Prereq:* *Fourth-year classification in veterinary medicine.* Two week introductory topics in beef production medicine with emphasis on monitoring disease, disease prevention, and production economics. Fifteen hours recitation/discussion and 20 hours clinical experience per week.

VDPAM 482. Beef Production Medicine Preceptorship. (0-40) Cr. 1-6 each time taken. F.S.SS. *Prereq:* 481. Two week advanced course in beef production medicine with emphasis on herd management, production analysis, and problem solving. Forty hours clinical experience per week. Assignments will include preceptorships with a practicing veterinarian and/or a production unit.

VDPAM 483. Advanced Beef Production Medicine. (15-20) Cr. 2. F.S. *Prereq:* 481. Two week advanced clinical rotation in beef production medicine. Fifteen hours recitation/discussion and 20 hours clinical experience per week. The instructor will lead field trips as well as problem solving exercises where the student will apply concepts of herd management, production analysis, and disease prevention.

VDPAM 484. Introduction to Dairy Production Medicine. (15-20) Cr. 2. SS. *Prereq:* *Fourth-year classification in veterinary medicine.* Two week introductory topics in dairy production medicine with emphasis on monitoring disease, disease prevention, and

production economics. Fifteen hours recitation/discussion and 20 hours clinical experience per week.

VDPAM 485. Dairy Production Medicine Preceptorship. (0-40) Cr. 1-6 each time taken. F.S.SS. *Prereq:* *VDPAM 484.* Two week advanced course in dairy production medicine with emphasis on herd management, production analysis, and problem solving. Forty hours clinical experience per week. Assignments will include preceptorships with a practicing veterinarian and/or a production unit.

VDPAM 486. Introduction to Small Ruminant Production Medicine. (15-20) Cr. 2. SS. *Prereq:* *Fourth-year standing in veterinary medicine.* Two week introductory topics in small ruminant production medicine with emphasis on monitoring disease, disease prevention, and production economics. Fifteen hours recitation/discussion and 20 hours clinical experience per week.

VDPAM 487. Livestock Disease Prevention. (3-0) Cr. 3. S. A survey of diseases of large domestic animals, including discussion of causes, transmission, and control. Designed for students majoring in agricultural sciences.

VDPAM 490. Independent Study. Cr. 1 to 5. F.S.SS. *Prereq:* *Permission of department chair.*

VDPAM 495. Seminar. (Same as V C S 495.) Cr. R. S. *Prereq:* *Fourth-year classification in veterinary medicine.* Seminars and case discussions on selected subjects by staff of the College of Veterinary Medicine and others, including student presentations. Offered on a satisfactory-fail grading basis only.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

VDPAM 522. Principles of Epidemiology. (Same as V MPM 522.) (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* *Micro 310 or 380 or 386.* Epidemiology and ecology of disease in populations. Disease causality and epidemiologic investigation. Issues in disease prevention, control, and eradication.

VDPAM 526. Veterinary Toxicology. (Dual-listed with 426.) Cr. 3. S. *Prereq:* *Permission of instructor.* A study of the disease processes in animals caused by toxicants and the use of differential diagnostic and therapeutic procedures.

VDPAM 590. Special Topics. Cr. 1 to 3. *Prereq:* *Permission of instructor.* Topics in medicine, surgery, theriogenology; beef, swine, dairy, or sheep production medicine.

Courses for Graduate Students

VDPAM 650. Swine Diagnostic Medicine. Cr. 1-4. SS. *Prereq:* *DVM degree. Permission of instructor.* A detailed study of swine diseases emphasizing the pathogenesis and diagnosis of swine respiratory, enteric, reproduction, metabolic, and septicemic diseases.

VDPAM 651. Disease Dynamics in Swine Production Medicine. Cr. 2. F. *Prereq:* *DVM degree, permission of instructor.* A detailed study of disease dynamics, prevention and control in food producing animal populations, emphasis on swine epidemiological issues pertinent to production medicine.

VDPAM 652. Analytical Methods in Swine Production Medicine. Cr. 2. S. *Prereq:* *DVM degree, permission of instructor.* An overview of experimental and observational study designs, analytical techniques and data interpretation, emphasis on methodologies pertinent to swine production medicine.

VDPAM 653. Clinical Trials in Production Medicine. Cr. 1. SS. *Prereq:* *DVM degree, permission of instructor.* Application of clinical trials in production medicine. Study design and execution and data analysis, interpretation, and reporting.

VDPAM 654. Comparative Anti-microbial Clinical Pharmacology. Cr. 2. Alt. S., offered in 2000. *Prereq:* *Graduate student, resident, or intern in College of Veterinary Medicine.* Initial antimicrobial selection for infectious diseases of domestic animals. The antimicrobial drug groups will be examined, stressing pharmacokinetics, minimal inhibitory concentrations, and

the use of these parameters to select appropriate compounds and dosages for maximum efficacy.

VDPAM 655. Advanced Swine Production Medicine. Cr. 1-4. S. Prereq: DVM degree and permission of instructor. Detailed overview of applied techniques used in swine production medicine; production modeling and record analysis, production economics and financial analysis, therapeutic and vaccination strategies, quality control procedures and food safety.

Veterinary Medicine

Richard F. Ross, Dean

Eldon K. Uhlenhopp, Associate Dean

Prem S. Paul, Associate Dean

Courses Primarily for Undergraduate Students

V Med 120. Career Opportunities in Veterinary Medicine. (1-0) Cr. 1. S. Presentations by veterinarians who are practicing in the many aspects of either private, public, or institutional practice. Designed for pre-veterinary students and others interested in veterinary medicine as a career. Offered on a satisfactory-fail grading basis only.

Courses Primarily for Professional Students

V Med 300. Professional Orientation. (1-0) Cr. R. F. 8 weeks. Prereq: First-year classification in veterinary medicine. An orientation to the College of Veterinary Medicine at ISU and the veterinary medicine profession.

V Med 303. Ethical Issues in Veterinary Medicine. (1-3) Cr. 2. F. Prereq: Second year classification in Veterinary Medicine. Selected topics on moral, ethical, and legal issues affecting the practice of veterinary medicine.

V Med 304. Introduction to Clinical Problem Solving. (Same as V Pth 304.) (0-4) Cr. 2. F. Prereq: First year classification in Veterinary Medicine. Application of knowledge in basic biomedical sciences to clinical problems using a small group, problem-based learning format.

V Med 402. Seminar in International Veterinary Medicine. (1-0) Cr. 1. S. 8 weeks. Prereq: Third-year classification in veterinary medicine. Selected topics on international perspectives of veterinary medicine.

V Med 403. International Preceptorship. (0-40) Cr. 1-12 each time taken. F.S.SS. Prereq: Second-year classification in veterinary medicine. International preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

V Med 451. Fundamental Microcomputer Applications in Veterinary Medicine. (1-3) Cr. 1. F.S. 8 weeks. Prereq: Fourth-year classification in veterinary medicine. Introduction to microcomputer hardware and software for practice management. Discussion and use of special application software available for word processing, spreadsheet analysis, and veterinary practice management.

V Med 490. Independent Study. Cr. 1 to 3. Prereq: Classification in veterinary medicine. Independent or small group study of a specific area for which no course is available in an existing department.
H. Honors

V Med 503. International Preceptorship. (0-40) Cr. 1-12 each time taken. F.S.SS. Prereq: Admission to the Graduate College. International preceptorships and Study Abroad Group programs. This course will provide opportunities for students to be involved in applied clinical, production, and/or research experi-

ences in international locations. The course consists of 40 hour per week experiential learning opportunities.

Veterinary Microbiology & Preventive Medicine

Charles O. Thoen, Interim Chair of Department

Distinguished Professors: Kaerberle, Ross, Roth

Professors: Chevillie, Kramer, Moon, Paul, Platt, Rosenbusch, Thoen

Professors (Collaborators): Arambulo, S. Bolin, Donham, Larsen, Mengeling, Nystrom-Dean, O'Berry, Schmerr, Schultz, Tabatabai

Distinguished Professors (Emeritus): Beran, Packer, Switzer

Professors (Emeritus): Hogle

Associate Professors: Abou-Gabal, Carpenter, Dickson, Griffith, Minion, Reynolds, B. Thacker, Uhlenhopp, Wannemuehler, Zimmerman

Associate Professors (Collaborators): C. Bolin, Frey, Kehrl, Zuerner

Assistant Professors: Yoon

Assistant Professors (Adjunct): Flaming, E. Thacker,

Assistant Professors (Collaborators): Anderson, Currier, Halling, Harp, Sacco, Stabel, Stanton, Wesley

The Department of Veterinary Microbiology and Preventive Medicine offers instruction in the areas of bacteriology, mycology, virology, immunology, epidemiology and public health at the graduate level.

Microbiologic, immunologic, regulatory, and preventive medical aspects of infectious diseases of animals are emphasized in courses for students in the veterinary curriculum.

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see *Veterinary Medicine, Curriculum*.

The Department of Veterinary Microbiology and Preventive Medicine provides instruction on pathogenic bacteria, fungi, and viruses and their interaction with host animal species. Principles and applications of infectious diseases, immunity to disease, diagnostic methods for infectious diseases, and vaccinology are covered. Principles and applications of epidemiology, public health, preventive veterinary medicine, regulatory veterinary medicine and food safety are also emphasized.

Graduate Study

The department offers opportunities for the degree doctor of philosophy with a major in veterinary microbiology. A specialization in preventive medicine is an option for this degree. Graduates in the Veterinary Microbiology and Preventive Medicine programs have a broad understanding of the fundamental processes involved in infectious diseases, pathogenesis

and immunology. They are able to effectively establish research programs, which involve complex biological systems and disease syndromes. They are also prepared to address microbial-based social, ethical and environmental problems. Graduates acquire effective written and oral communication skills which lead to successful research and teaching careers in the medical and veterinary sciences. The department also offers work towards the master of science with majors in veterinary microbiology, or veterinary preventive medicine. A non-thesis master's option is available for majors in preventive medicine. Courses are open for students majoring in other graduate programs.

Prerequisite to graduate study is completion of coursework in general microbiology, biology, biochemistry, mathematical sciences, and physics. Candidates for the majors in veterinary microbiology should possess an undergraduate degree in biomedical science with emphasis in medical microbiology or the D.V.M. degree. Candidates for the major in preventive medicine should possess the D.V.M. degree.

The department also participates in the interdepartmental majors and programs in genetics, immunobiology, and MCDB (molecular, cellular, and developmental biology (see *Index*).

Each graduate student must demonstrate proficiency in English composition within two semesters in residence.

Courses Primarily for Professional Students

V MPM 378. Case Study IV. (0-4) Cr. 2. S. Prereq: Second-year classification in veterinary medicine. Clinical applications of basic science.

V MPM 380. Veterinary Immunology. (3-3) Cr. 2. S. 8 weeks. Prereq: First-year classification in veterinary medicine. Structure and function of the immune system in animals.

V MPM 386. Veterinary Microbiology I. (3-5) Cr. 5. F. Prereq: Second-year classification in veterinary medicine. Bacteria and fungi of veterinary importance with emphasis on mechanisms of disease production and laboratory diagnostic procedures.

V MPM 387. Veterinary Microbiology II. (3-0) Cr. 3. S. Prereq: Second-year classification in veterinary medicine. The nature and ecology of rickettsiae and animal viruses. Pathogenesis of viral diseases. The role of the immune response in pathogenesis and immunity to viral diseases.

V MPM 388. Public Health. (3-0) Cr. 3. S. Prereq: Second-year classification in veterinary medicine. Principles and practice of epidemiology. Relationships of animals to human health and well-being including zoonotic diseases, safety of food products of animal origin, water safety, and handling of animal wastes.

V MPM 389. Clinical Mycology. (1-2) Cr. 2. F. Prereq: Second-year classification in veterinary medicine or 310. Fungal pathogens, common mycotoxins and the associated diseases in animals and humans with emphasis on clinical laboratory diagnosis.

V MPM 390. Topics in Veterinary History. (2-0) Cr. 1. S. 8 weeks. Significant persons, noteworthy events, and pivotal scientific discoveries in the course of the development and advancement of veterinary medicine from ancient times to the present.

V MPM 403. The Human-Animal Bond. (1-0) Cr. 1. F. Prereq: Enrollment in veterinary medicine. Concepts of the human-animal bond including history, philosophy, and effects on individuals and society.

V MPM 409. Infectious Diseases of Captive Wild Animals. (1-0) Cr. 1. F. Prereq: Third year classification in veterinary medicine. Infectious diseases (bacterial, viral, and mycotic) of non-human primates,

birds, ruminants, cold-blooded animals, marine mammals, and carnivores.

V MPM 436. Infectious Diseases and Preventive Medicine. (2-0) Cr. 2. F. Prereq: *Third-year classification in veterinary medicine.* Etiology, epidemiology, laboratory diagnosis, regulatory control and preventive medicine aspects of the infectious diseases of animals.

V MPM 437. Infectious Diseases and Preventive Medicine. (3-0) Cr. 3. S. Prereq: *Third-year classification in veterinary medicine.* Continuation of 436.

V MPM 484. Laboratory in Clinical Microbiology. Cr. 1 each time taken. F.S.SS. Prereq: *Fourth year classification in veterinary medicine.* Application of microbiological and immunological procedures to the diagnosis of infectious and immunologically mediated diseases.

V MPM 486. Laboratory in Public Health. Cr. 1 each time taken. F.S. Prereq: *Fourth-year classification in veterinary medicine.* Laboratory exercises and field trips related to veterinary public health practices.

V MPM 522. Principles of Epidemiology. (Same as VDPAM 522.) (3-0) Cr. 3. Alt. S., offered 2000. Prereq: *Micro 310 or 380 and 386.* Epidemiology and ecology of disease in populations. Disease causality and epidemiologic investigation. Issues in disease prevention, control, and eradication.

V MPM 540. Livestock Immunogenetics. (Same as An S 540.) See *Animal Science.*

V MPM 586. Medical Bacteriology. (Same as Micro 586.) (4-0) Cr. 4. F. Prereq: *Permission of instructor.* Bacteria associated with diseases of vertebrates, including virulence factors and interaction of host responses.

V MPM 586L. Medical Bacteriology Laboratory. (0-6) Cr. 2. F. Prereq: *credit or enrollment in 586 or 625.* Procedures used in isolation and identification of pathogenic bacteria, including molecular and genetic techniques used in research.

V MPM 599. Creative Component. Cr. arr. Prereq: *Nonthesis M.S. Option only.* A written report based on laboratory research, library reading, or topics related to the student's area of specialization and approved by the student's advisory committee.

Courses for Graduate Students

V MPM 604. Seminar. (1-0) Cr. 1 each time taken. F.S. Offered on a satisfactory-fail grading basis only.

V MPM 608. Molecular Virology. (Same as PI P 608.) (3-0) Cr. 3. Alt. S., offered 2000. Prereq: *BBMB 405 or Gen 520.* Advanced study of virus host-cell interactions. Molecular mechanisms of viral replication and pathogenesis.

V MPM 615. Molecular Immunology. (Same as BBMB 615.) See *Biochemistry, Biophysics, and Molecular Biology.*

V MPM 620. Advanced Molecular Genetics. (Same as Gen 620.) See *Genetics.*

V MPM 625. Mechanisms of Bacterial Pathogenesis. (Same as Micro 625.) (4-0) Cr. 4. Alt. S., offered 2001. Prereq: *386 and 520.* Advanced study of virulence mechanisms of bacteria and current knowledge of research on host defenses in the pathogenesis of bacterial infections.

V MPM 629. Medical Immunology II. (4-0) Cr. 4. S. Prereq: *520 or 575.* Current concepts of the role of native and acquired immunity in health and disease.

V MPM 690. Current Topics. Cr. 1 to 3 each time elected. F.S.SS. Prereq: *Permission of instructor.* Colloquia or advanced study of specific topics in a specialized field.

- A. Immunology
- B. Infectious Diseases

V MPM 698. Seminar in Molecular, Cellular, and Developmental Biology. (Same as MCDB 698.) See *Molecular, Cellular, and Developmental Biology.*

V MPM 699. Research.

Veterinary Pathology

Norman F. Cheville, Chair of Department
University Professors: Kluge

Professors: Carson, Cheville, Hagemoser, Hopper, Hyde, Moon, Myers, Niyo, Osweiler

Professors (Collaborators): Bolin, Meador

Professors (Emeritus): Daniels, Greve, Holter, Jeska, Ledet, Miller, Seaton, Stahr

Associate Professors: Ackermann, Halbur, Haynes, Janke, Jarvinen, Larson, Yaeger

Assistant Professors: Andreasen, Beetham, Howard, Sorden

Assistant Professors (Collaborators): Brees, Ellingson, Palmer, Rhyan

Instructors (Adjunct): Fales, Hostetter, Morgan, Pendry, Thomsen, Wunn

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see *Veterinary Medicine, Curriculum.*

The Department of Veterinary Pathology offers a systematic study of basic disease mechanisms with emphasis on the changes in cells, tissues, organs, and body fluids associated with disease. The theory and practice of veterinary pathology, veterinary clinical pathology, veterinary parasitology, veterinary toxicology, and related disciplines provide the basis for accurate diagnosis and a rational approach to the treatment and prevention of animal diseases.

Graduate Study

The department offers work for the degree master of science and doctor of philosophy with a major in veterinary pathology. As an option, students within the veterinary pathology major may choose an area of specialization in cellular and molecular pathology, veterinary clinical pathology, veterinary toxicology, or veterinary parasitology. The master of science degree is available on a thesis or nonthesis basis in the veterinary pathology major with or without an area of specialization.

Graduates have a broad understanding of veterinary pathology and related disciplines. They are able to communicate with clinicians, other scientists, and other colleagues on scientific matters, and with the general public on science policy matters that relate to veterinary pathology.

Graduates are able to address complex problems facing the agricultural and biomedical sciences, and are able to make appropriate diagnoses and investigations of animal diseases. They consider ethical, social, legal and environmental issues, and are skilled at carrying out research, communicating research results, and writing concise and persuasive grant proposals.

A minor in veterinary pathology requires a minimum of 12 graduate credits at the Ph.D. level and 8 graduate credits at the M.S. level. Additionally, a faculty member from the department must be a member of the student's program of study committee.

A veterinary degree (doctor of veterinary medicine or equivalent) is required for the major in veterinary pathology and Veterinary Clinical Pathology. Other specializations do not require the veterinary degree. A minimum score of 550 is required on the TOEFL examination for students whose native language is not English. Scores on the standardized Graduate Record Examination (GRE) General Test are required of students not having a veterinary degree from the United States or Canada. The GRE General Test is strongly recommended for all other applicants. The foreign language requirement will be determined by the student's program of study committee with the approval of the departmental chair. The Graduate English Examination is a graduate college requirement for native English speakers.

The M.S. thesis degree in veterinary pathology, with or without an area of specialization, requires a minimum of 30 graduate credits. Following completion of all other requirements, a comprehensive final examination is administered covering all graduate work including the thesis. The examination is typically oral, but a written component may be specified by the program of study committee. The degree candidate must submit a thesis, including at least one manuscript suitable for publication, to the major professor at least one week prior to the final examination. The departmental requirement for graduate courses includes 3 credits of basic biological sciences (biochemistry, genetics, cell biology), 4 credits of statistics (Stat 401), 4 credits of systemic pathology (from V Pth 570 or 571), 1 credit of post-mortem pathology (V Pth 551) 1 credit of seminar (V Pth 605 or 500), and a significant number of research credits (V Pth 699).

The M.S. nonthesis degree in veterinary pathology, with or without an area of specialization, requires a minimum of 40 graduate credits including at least 10 graduate credits earned outside the department. Every nonthesis master's degree program requires evidence of individual accomplishment demonstrated by completion of a creative component, special report, or scientific study. A minimum of 3 credits of such independent work (V Pth 599) and a practical diagnostic examination (V Pth 606) corresponding to the area of specialization are required on every program of study. The final examination is comprehensive and consists of written and oral questions. The departmental requirement for graduate courses includes those for the M.S. thesis degree plus additional courses corresponding to the area of degree emphasis of specialization. Contact the department for a more complete list of requirements and information on areas of specialization.

The Ph.D. degree in veterinary pathology, with or without an area of specialization, requires a minimum of 72 graduate credits including at least 12 graduate credits earned outside the

department. A minor is encouraged, but not required. The preliminary examination, consisting of written and oral components, is comprehensive and not restricted to the content of graduate courses. The degree candidate must submit a dissertation, including at least two manuscripts suitable for publication, to the major professor at least one week prior to the final examination. The final examination is primarily a defense of the dissertation, but it may include questions on other areas of specialized knowledge. Contact the department for a more complete list of requirements for the Ph.D. degree and information on areas of specialization.

Minor work is recommended in other departments in the College of Veterinary Medicine or departments or programs in other colleges. The department participates in the interdepartmental program in immunobiology and the interdepartmental major in toxicology. (See *Index*.)

Courses Primarily for Undergraduate Students

V Pth 304. Introduction to Clinical Problem Solving. (Same as V Med 304.) See *Veterinary Medicine*.

V Pth 342. General Pathology. (Dual-listed with 542.) (3-2) Cr. 2. S. 8 weeks. Offered second half semester only. *Prereq:* First-year classification in *veterinary medicine*. Basic pathology with emphasis on disease in animals.

V Pth 372. Systemic Pathology. (2-3) Cr. 3. F. *Prereq:* 342. Response to injury by each body system.

V Pth 376. Veterinary Parasitology. (Dual-listed with 576.) (3-3) Cr. 4. F. *Prereq:* Second-year classification in *veterinary medicine*. Parasitic diseases of domestic animals and their control.

V Pth 377. Case Study III. (0-4) Cr. 2. F. *Prereq:* Second-year classification in *veterinary medicine*. Clinical applications of basic science.

V Pth 401. Basics of Medical Terminology. (1-0) Cr. 1. F. 8 weeks, offered second half semester only. Discussion of prefixes, suffixes, and roots (mostly from Latin and Greek) that comprise medical terms.

V Pth 405. Analytical Toxicology. Cr. 1. F. S. Demonstration of and experience with modern analytical chemical techniques for analysis of toxicants in field samples from diagnostic cases.

V Pth 406. Surgical Pathology. (1-0) Cr. 1. S. *Prereq:* 372. Biopsies and associated cases reviewed with students in a seminar format. Interpretation of histopathologic findings as an adjunct to diagnosis, prognosis, and management of clinical cases.

V Pth 407. Parasites of Laboratory and Exotic Animals. (1-0) Cr. 1. S. *Prereq:* Third- or fourth-year classification in *veterinary medicine*. Discussion of important parasitisms occurring as natural infections in laboratory animals and exotic pet animals. Rodents, primates, reptiles, and caged birds are examples of hosts discussed.

V Pth 408. Clinical Pathology Interpretation. (1-0) Cr. 1. S. *Prereq:* 425. Interpretation of laboratory data on a series of clinical cases supplemented by current literature review.

V Pth 409. Introduction to Veterinary Cytology. (1-0) Cr. 1. F. S. *Prereq:* Second or third-year classification in *veterinary medicine*. Description and interpretation of cellular preparations from tissues and body fluids.

V Pth 410. Llama Medicine. (1-0) Cr. 1. S. *Prereq:* Third-year classification in *veterinary medicine*. Introduction to basic camelid medicine, including anatomy, behavior, restraint, handling, husbandry, herd health, common diseases, surgical conditions, and anesthesia protocols.

V Pth 422. Special Pathology. (3-3) Cr. 4. S. *Prereq:* 372. Pathogenesis of diseases in domestic animals.

V Pth 425. Clinical Pathology. (1-4) Cr. 3. F. *Prereq:* 372. Principles of clinical hematology and clinical chemistry in domestic animals.

V Pth 426. Veterinary Toxicology. (Dual-listed with 526; same as VDPAM 426.) (3-0) Cr. 3. S. *Prereq:* Third-year classification in *veterinary medicine*. A study of the disease processes in animals caused by toxicants and the use of differential diagnostic and therapeutic procedures.

V Pth 456. Necropsy Laboratory Practicum. Cr. 1 each time taken. *Prereq:* Fourth-year classification in *veterinary medicine*. Practicum in postmortem examination and diagnosis.

V Pth 457. Clinical Pathology Laboratory Practicum. Cr. 1 each time taken. *Prereq:* Fourth-year classification in *veterinary medicine*. Methodology in clinical chemistry, hematology and cytology; practice in interpretation of laboratory data.

V Pth 478. Global Protozoology - Molecular Biology of Protozoa. (2-1) Cr. 3. F. *Prereq:* Permission of instructor. Analysis of cellular systems, molecules, and organelles of pathogenic protozoan parasites. Emphasis is placed on processes and systems that are unique to protozoa, are important to understanding vector-parasite-host biology/ecology, or are targets of disease prevention/treatment programs for international disease control.

V Pth 490. Independent Study. Cr. arr. *Prereq:* Permission of instructor and department chair.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

V Pth 500. Toxicology Seminar. (Same as Tox 500.) (1-0) Cr. 1 each time taken. F. S. *Prereq:* Permission of instructor. Presentation of a seminar about a current topic in toxicology as part of a weekly series of seminars by graduate students, faculty, and guest lecturers from off campus.

V Pth 501. Principles of Toxicology. (Same as Tox 501, Zool 501.) (3-0) Cr. 3. S. *Prereq:* BBMB 404 or equivalent. Principles of toxicology governing entry, fate, and effects of toxicants on living systems. Includes toxicokinetics and foreign compound metabolism relative to toxification or detoxification. Fundamentals of foreign compound effects on metabolism, physiology, and morphology of different cell types, tissues, and organ systems.

V Pth 502. Toxicology Methods. (Same as Tox 502, Zool 502.) (0-6) Cr. 3. Alt. F., offered 1999. *Prereq:* 501. Provides demonstrations or laboratory experience in the application of methods used in toxicology, including safety procedures, calculation and data analysis, mutagenicity tests, cell culture, residue analysis, teratologic and morphologic evaluation, electrophysiologic measures, in vitro enzyme induction/biotransformation, neural and behavioral toxicology testing.

V Pth 526. Veterinary Toxicology. (Dual-listed with 426; same as Tox 526, VDPAM 526) (3-0) Cr. 3. S. *Prereq:* Graduate classification and 542. A study of disease processes in animals caused by toxicants and the use of differential diagnostic and therapeutic procedures.

V Pth 542. General Pathology. (Dual-listed with 342.) (3-2) Cr. 2. S. 8 weeks, offered second half semester only. *Prereq:* Graduate classification and BMS 330, 332, or Zool 322; for graduate credit. Basic pathology with emphasis on disease in animals.

V Pth 546. Clinical and Diagnostic Toxicology. (Same as Tox 546.) (0-3 to 0-9) Cr. 1 to 3 each time taken. F. S. S. *Prereq:* D.V.M. degree or 526. Advanced study of current problems and issues in toxicology. Emphasis on problem solving utilizing clinical, epidemiological, and laboratory resources.

V Pth 548. Diagnostic Parasitology Laboratory. (0-3 to 0-9) Cr. 1 to 3. F. S. S. *Prereq:* 376 or 576. A laboratory experience in the technical and applied aspects of veterinary parasitology.

V Pth 549. Clinical Pathology Laboratory. (0-3) Cr. 1 each time taken. F. S. S. *Prereq:* 457. Laboratory procedures and clinical interpretations with emphasis on hematology, cytology, and clinical chemistry. Offered on a satisfactory-fail grading basis only.

V Pth 550. Surgical Pathology Laboratory. (0-3 to 0-9) Cr. 1 to 3 each time taken. F. S. S. *Prereq:* 422, 570 or 571. Diagnosis of lesions in biopsy specimens; classification of neoplasms. Course includes rotation through departmental biopsy service and review of selected cases from departmental archives. Offered on a satisfactory-fail grading basis only.

V Pth 551. Postmortem Pathology Laboratory. (0-3 to 0-9) Cr. 1 to 3 each time taken. F. S. S. *Prereq:* 542 or 422. Necropsy techniques of animals with emphasis on gross and microscopic lesions and diagnosis. Offered on a satisfactory-fail grading basis only.

- A. Veterinary Pathology
- B. Veterinary Diagnostic Laboratory

V Pth 554. Ethics in Scientific Research and Writing. (1-0) Cr. 1. Alt. S., offered 2000. *Prereq:* Graduate classification. Ethical conduct in biomedical research, criticism, writing, and adherence to regulations.

V Pth 555. Neurobehavioral Toxicology. (Same as Tox 555.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq:* 501. Advanced study of neurotoxicology and behavior. Emphasis on methods in neurobehavioral toxicology and the effects of a broad spectrum of neurotoxic agents.

V Pth 570. Systemic Pathology I. (2-4) Cr. 1 to 4. Alt. F., offered 1999. *Prereq:* 342 or 542. Pathology of the respiratory, reproductive, endocrine, musculoskeletal, and cardiovascular systems. Emphasis on pathogenesis and anatomic pathology correlated with interpretive clinical pathology where appropriate.

V Pth 571. Systemic Pathology II. (2-4) Cr. 1 to 4. Alt. F., offered 2000. *Prereq:* 342 or 542. Pathology of the integumentary, urinary, digestive, lymphoid, and nervous systems and special senses. Emphasis on pathogenesis and anatomic pathology correlated with interpretive clinical pathology where appropriate.

V Pth 576. Veterinary Parasitology. (Dual-listed with 376.) (4-3) Cr. 5. S. *Prereq:* Graduate classification and 542. For graduate credit. Parasitic diseases of domestic animals and their control.

V Pth 578. Global Protozoology - Molecular Biology of Protozoa. (2-1) Cr. 3. F. *Prereq:* Permission of instructor. Analysis of cellular systems, molecules, and organelles of pathogenic protozoan parasites. Emphasis is placed on processes and systems that are unique to protozoa, are important to understanding vector-parasite-host biology/ecology, or are targets of disease prevention/treatment programs for international disease control.

V Pth 590. Special Topics. Cr. 1 to 4. F. S. S. *Prereq:* Permission of instructor.

- A. Veterinary Pathology
- B. Veterinary Parasitology
- C. Veterinary Toxicology
- D. Veterinary Clinical Pathology

V Pth 599. Creative Component Research

- A. Veterinary Pathology
- B. Veterinary Parasitology
- C. Veterinary Toxicology
- D. Veterinary Clinical Pathology

Courses for Graduate Students

V Pth 604. Pathology Case Seminar. Cr. 1 to 2 each time taken. F. S. Description and interpretation of microscopic lesions and clinical pathology data collected from cases of natural and experimental disease. Offered on a satisfactory-fail grading basis only.

V Pth 605. Current Topics Seminar. Cr. 1 each time taken. F. S.

V Pth 606. Diagnostic Interpretation. Cr. R. F. S. S. A comprehensive examination in the diagnostic description and interpretation of case materials relevant to veterinary pathology and areas of specialization.

- A. Veterinary Pathology
- B. Veterinary Parasitology

- C. Veterinary Toxicology
- D. Veterinary Clinical Pathology

V Pth 643. Natural Toxins. (Same as Tox 643.) (1-6) Cr. 3. Alt. F., offered 2000. *Prereq: Courses in biochemistry and physiology.* Naturally occurring toxins in foods and feeds; poisonous plants and venoms.

V Pth 645. Agricultural and Environmental Analytical Toxicology. (Same as Tox 645.) (1-3) Cr. 2. F. *Prereq: Chem 211, 322.* Analysis and interpretation of toxicant residues in animal tissues, feeds, water, soil, and other environmental specimens.

V Pth 652. Pathologic Hematology. (2-2) Cr. 3. Alt. S., offered 2001. *Prereq: 425.* Pathologic changes in blood constituents of domestic animals.

V Pth 653. Research Methods in Pathobiology. (2-0) Cr. 2. F. *Prereq: Permission of instructor.* Introduction to laboratory techniques for study of pathologic changes in cells and tissues, including: microscopy, cytochemistry, and molecular pathology techniques. Offered on a satisfactory-fail grading basis only.

V Pth 655. Cellular and Molecular Pathology I. (3-0) Cr. 3. Alt. S., offered 2001. *Prereq: Graduate course in biochemistry, genetics, or cell biology.* Cellular and molecular mechanisms of cell injury, circulatory dysfunction, and the inflammatory response.

V Pth 656. Cellular and Molecular Pathology II. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq: Graduate course in biochemistry, genetics, or cell biology.* Cellular and molecular mechanisms of neoplasia and toxicologic pathology.

V Pth 660. Pathology of Parasitic Diseases. (2-3) Cr. 3. Alt. SS., offered 2000. *Prereq: 372, 376.* Gross and microscopic tissue changes caused by parasitic arthropods and helminths.

V Pth 663. Clinical Chemistry. (2-2) Cr. 3. Alt. S., offered 2000. *Prereq: 425.* The pathophysiology, methodology, and clinical application of laboratory medicine.

V Pth 679. Histopathology of Laboratory Animals. (0-4) Cr. 2. Alt. SS., offered 2000. *Prereq: 570 or 571.* Study of microscopic lesions in laboratory animals with emphasis on description, etiology, pathogenesis, and diagnosis.

- V Pth 699. Research.**
- A. Veterinary Pathology
 - B. Veterinary Parasitology
 - C. Veterinary Toxicology
 - D. Veterinary Clinical Pathology

Water Resources

(Interdepartmental Graduate Major)

Supervisory Committee: R. Horton, Chair; T. Al Austin, J. L. Baker, J. A. Herriges, W. W. Simpkins

Water resources is a university-wide, interdisciplinary program involving biological, chemical, physical, and social sciences. Faculty from departments in the colleges of Agriculture, Engineering, and Liberal Arts and Sciences cooperate to offer courses and research opportunities leading to the M.S. and Ph.D. degrees with a major in water resources.

Although broadly trained, water resources majors specialize in some technical aspect of water resources, and applicants should have completed the equivalent of an undergraduate or masters degree in one of the biological, chemical, physical, or engineering sciences.

The water resources program emphasizes fundamental concepts and research, which at the same time address water resources issues having regional and national significance. The curriculum is designed to provide the interdisciplinary approach needed in water resources education and research. In addition to work in their chosen area of specialization, students may obtain a broad background in water resources encompassing physical, chemical, and biological aspects of water resources. Cooperating departments offer courses covering surface water and groundwater hydrology, meteorology, climatology, water quality, aquatic and wetland ecology, water resources engineering, and sociological, political, and economic aspects of water resources planning and management.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

W Res 583. Water Resources. (Same as Econ 583.) (3-0) Cr. 3. S. *Prereq: Graduate classification; not for economics majors.* Analysis of water resource management issues from economic, legal, political, and sociological perspectives. Topics include rational water allocation systems, market failure, investment, pollution control strategies, and resource management. Administered by Economics in cooperation with Political Science and Sociology.

W Res 590. Special Topics. Cr. var. *Prereq: Permission of major professor in water resources faculty.* Literature reviews and conference in accordance with needs and interest of the student.

W Res 599. Creative Component. Cr. var. *Prereq: Permission of major professor in water resources faculty.* Creative component for nonthesis master of science degree.

W Res 690. Seminar in Water Resources Management. (1-0) F.S.

- A. Cr. 1. Presentation required.
- B. Cr. R. Attendance only.

Women's Studies

(Interdepartmental Undergraduate Major)

Program Director: J. Bystydzienski

Undergraduate Study

Women's Studies in the College of Liberal Arts and Sciences is a cross-disciplinary program in which students may elect a minor or a major. Women's Studies provides an opportunity for students to examine women's roles, contributions, and status in social and cultural context and to investigate a variety of disciplines from feminist perspectives. Women's Studies graduates are skilled in critical thinking, research methods, and effective communication. Because they have developed a thorough understanding of gender, race, and class, they can understand and work effectively with employers, colleagues, and clients to analyze and address complex social problems. Women's Studies graduates acquire strong backgrounds for careers in such areas as counseling, human resources, public policy, politics, business, or law. The program includes at various times core courses in Women's Studies and cross-listed courses in art history, classical studies, economics, English, foreign languages and literatures, history, health and human performance, political science, psychology, reli-

gious studies, sociology, speech communication, and zoology.

An undergraduate major requires 35 credits of core, cross-listed, and independent study courses chosen with the assistance of a Women's Studies adviser. Women's Studies majors must also declare either a minor or a second major in a different program or department.

English proficiency requirement: The Women's Studies major requires an average grade of C- or better in English 104 and 105 (or 105H) and successful completion of either English 305, English 314, a foreign language 370 course, or W S 499.

Undergraduate students may minor in Women's Studies by taking 15 semester hours of Women's Studies classes, including W S 201, 301, or 401.

Because course listings vary from year to year, any student interested in a minor or major in Women's Studies should contact the chair of the program committee for advising. (See *Index, Cross-Disciplinary Programs.*)

The following women's studies courses are applicable to the human relations requirement for teachers: 201, 327, 340, 345, 346, 370, 385, 386. (See *Index, Teacher Education Program.*)

Graduate Study

Courses open for nonmajor graduate credit: 321, 323, 336, 340, 345, 350, 394, 401, 422, and 450.

Courses Primarily for Undergraduate Students

W S 201. Introduction to Women's Studies. (3-0) Cr. 3. F.S. Introduction to the interdisciplinary field of Women's Studies. Contemporary status of women mainly in the United States from social, economic, historical, political, philosophical and literary perspectives. Analysis of intersection of gender, race, class, and sexuality. Topics include sexuality, violence, work, health, and family. Background for the other courses in the program.

W S 258. Human Reproduction. (Same as Zool 258.) See *Zoology.*

W S 301. International Perspectives on Women and Gender. (3-0) Cr. 3. F. *Prereq: 201 or 3 credits in Women's Studies at the 300 level or above.* Study of women in a range of cultures, depending on faculty expertise. Special emphasis on women in development seen in postcolonial context.

W S 304. Creative Writing - Fiction. (Same as Engl 304.) See *English.* Acceptable only when offered as a course on women's writing.

W S 321. Economics of Discrimination. (Same as Econ 321.) See *Economics.* Nonmajor graduate credit.

W S 323. Gender and Communication. (Same as Sp Cm 323.) See *Speech Communication.* Nonmajor graduate credit.

W S 327. Sex and Gender in Society. (Same as Soc 327.) See *Sociology.*

W S 336. Women and Religion. (Same as Relig 336.) See *Religious Studies.* Nonmajor graduate credit.

W S 340. Survey of Women's Literature. (Same as Engl 340.) See *English.* Nonmajor graduate credit.

W S 345. Women and Literature: Selected Topics. (Same as Engl 345.) See *English.* Nonmajor graduate credit.

W S 346. Psychology of Women. (Same as Psych 346.) See *Psychology*.

W S 350. African American Women. (Same as Af Am 350.) (3-0) Cr. 3. S. Prereq: 201 or Af Am 201 or 3 credits in *Women's Studies* or *African American Studies* at the 300 level or above. Economic, social, political and cultural roles of African American women in the U.S. Includes literary, philosophical, and artistic expressions. Myths and realities explored. Nonmajor graduate credit.

W S 370F. French Studies in English. (Same as Frnch 370.) See *Foreign Languages and Literatures*. Acceptable only when offered as a course on women or feminism in French literature.

W S 370G. German Studies in English. (Same as Ger 370.) See *Foreign Languages and Literatures*. Acceptable only when offered as a course on women or feminism in German literature.

W S 374. Women in Classical Antiquity. (Same as Cl St 374.) See *Classical Studies*.

W S 377. Women and Imperialism. (Same as Hist 377.) See *History*.

W S 380. History of Women in Science, Technology, and Medicine. (Same as Hist 380.) See *History*.

W S 383. Women in Science and Engineering. (Same as Zool 383.) See *Zoology*.

W S 385. Women in Politics. (Same as Pol S 385.) See *Political Science*.

W S 386. History of Women in America. (Same as Hist 386.) See *History*.

W S 394. Women in Art. (Same as Art H 394.) See *Art History*. Nonmajor graduate credit.

W S 401. Feminist Theories. (3-0) Cr. 3. F. Prereq: 201 or 3 credits in *Women's Studies* at the 300 level or above. Current theories of feminism, the feminine and sexual difference. Problems in race, class, sexuality, ethnicity as they are developed in diverse feminisms. May include readings in lesbian, Black, post-colonial, psychoanalytic and postmodern thought. Nonmajor graduate credit.

W S 422. Women, Men, and the English Language. (Same as Engl 422.) See *English*. Nonmajor graduate credit.

W S 450. Topics in Women's Studies. (3-0) Cr. 3 each time taken, maximum of 6. S. Prereq: 201 or 3 credits in *Women's Studies* at the 300 level or above. Special and/or experimental topics in a specific discipline, e.g., women and education, women and religion, women and the law, women and science. Nonmajor graduate credit.

W S 490. Independent Study. Cr. 1 to 3 each time taken, maximum of 6. Prereq: Any two courses in *Women's Studies*, permission of instructor. The director of the Women's Studies Program Committee must be consulted in advance.

W S 491. Senior Practicum. (2-0) Cr. 2. F.S.SS. Prereq: Senior classification. Internship designed to provide an application of Women's Studies principles and methods in a workplace. To be arranged with an internal or external employer and conducted under the supervision of a member of the Women's Studies faculty.

W S 499. Senior Thesis. (2-0) Cr. 2. F.S.SS. Prereq: Senior classification. Senior thesis to be independently researched and written under the supervision of a member of the Women's Studies faculty.

Courses for Graduate Students, Open To Qualified Undergraduate Students

W S 523. Gender Roles and Sport. (Same as Ex Sp 523.) See *Health and Human Performance*.

W S 528. Sociology of Gender. (Same as Soc 528.) See *Sociology*.

W S 545. Readings in Women's Literature. (Same as Engl 545.) See *English*.

W S 590. Special Topics. Cr. var. Prereq: Permission of Women's Studies Program Committee. Independent study on a topic in women's studies.

W S 594. Women in Art. (Same as Art H 594.) See *Art History*.

Zoology and Genetics

M. Duane Enger, Chair of Department

University Professors: Dolphin

University Professors (Emeritus): Stadler

Professors: Ackerman, Atherly, Bishop, Brown, Campbell, Drewes, Enger, Haydon, Henderson, Hoffmann, Imsande, Lee, Mayfield, Myers, Peterson, Pollak, Schnable, Shen

Professors (Collaborators): Moorman, Palmer, Paradise, Shoemaker

Distinguished Professors (Emeritus): Ulmer

Professors (Emeritus): Buttrey, Hicks, Hollander, Jeska, Miller, Mutchmor, Pattee, Redmond, Robertson, Welshons

Associate Professors: Ambrosio, Brendel, Buss, Dobbs, Emery, Farrar, Ford, Girton, Ingebriksen, J. Johansen, K. Johansen, McCloskey, Minion, Peterson, Powell, Sakaguchi, Viles, Voytas

Associate Professors (Adjunct): D. Vleck, Wang

Associate Professors (Collaborators): Link, Mahajan, Tucker

Associate Professors (Emeritus): Shaw

Assistant Professors: Becraft, Chou, Gu, Janzen, Naylor, Powell-Coffman, C. Vleck

Assistant Professors (Adjunct): Coffman, Harkins, Pleasants

Assistant Professors (Collaborators): Bowen, Buck

Instructors (Collaborators): Dhannavada, Schwabbauer, Sime, Sojka

Undergraduate Study

The department offers majors in both genetics and zoology. Each major is available to students in both the College of Agriculture and the College of Liberal Arts and Sciences. The programs for these majors are listed below and under the Curricula in Agriculture. College requirements can be found under Curricula in Agriculture and Curriculum in Liberal Arts and Sciences. The department offers minors in both genetics and zoology. B.S./M.S. programs are available in which a student, with proper planning, can complete the requirements for both bachelor's and master's degrees in five years. Students interested in the B.S./M.S. program must apply during their sophomore year.

Training in either genetics or zoology may lead to employment in teaching, research, or any of a variety of health-related professions. In most cases, students should plan on continuing their education in graduate or professional school. Students with the B.S. degree may expect to find employment in the biotechnology, health, or food industries. Recent graduates have also developed careers in conservation biology,

technical writing, science journalism, technical sales, biological illustration, and genetic counseling.

The required course work and associated electives are designed to provide students with knowledge of the basic biological sciences, mathematics, chemistry, and physics. This background is essential for professions involving modern biological sciences. As part of these courses, students develop skills in problem solving, critical thinking, writing, research-related activities and an introduction to biological professions.

The respective communications and English proficiency requirements of both colleges are met by an average of C or better in Engl 104, 105 or 105H, and an additional English writing course. The lowest grade acceptable in any of these courses is C-. Students in the College of Agriculture must also achieve a C or better in an oral communications course.

A grade of C- or better is required in all biological science courses within the majors with a cumulative GPA of at least 2.0.

Specific entrance requirements for medical and health-related professions are established by the professional schools. Students interested in fulfilling preprofessional requirements for such professions as cytotechnology, dental hygiene, dentistry, human medicine, medical technology, nursing, optometry, pharmacy, physical therapy, physicians assistant, and veterinary medicine can major in either genetics or zoology while fulfilling the preprofessional requirements. (See *Preprofessional Study*.)

Genetics

Genetics is the scientific study of heredity. The understanding of heredity is fundamental to all the biological sciences. The department offers a full range of instruction in all aspects of genetics from the molecular genetics of microorganisms to population genetics.

In addition to basic degree requirements listed in the Curricula in Agriculture or the Curriculum in Liberal Arts and Sciences, genetics majors must satisfy the following requirements:

1. Biol 201, 201L, 202, 202L, 301, 301L, 302, 302L, 303, and Micro 302.
2. Gen 110, 410, 411, 491, and 460 or 462.
3. Eleven credits of calculus and statistics including at least one course in each.
4. Three years of chemistry and biochemistry.
5. One year of general college physics.
6. Nine credits for the degree in the College of Agriculture, and 6 credits for the degree in the College of Liberal Arts and Sciences, of support electives chosen from an approved list.
7. Majors in the College of Liberal Arts and Sciences must take one course that involves both humanities and biology such as history of science or bioethics. This course may also count toward a college group requirement. A list of acceptable courses is available from the departmental office.
8. Majors in the College of Agriculture must include Biol (A Ecl) 312 in their program.

The department offers a minor in genetics that may be earned by completing Biol 301, 301L, 302, 302L, Gen 410, 411 and 491. A Genetics major may not double major or minor in Biology.

Zoology

The study of zoology includes all aspects of animal life. The department offers instruction in a wide range of zoological subjects ranging from the structure and function of cells to the behavior of animals and their populations.

In addition to the basic degree requirements listed in the Curricula in Agriculture and the Curriculum in Liberal Arts and Sciences, zoology majors (including those preparing for professional programs in medical and other health-related fields) must complete satisfactorily the following requirements.

1. Zool 110, Biol 201, 201L, 202, 202L, 301, 301L, 302, 302L, and Zool 355.
2. Zoology electives: 17 credits in zoology at the 300 level or above are required including seven credits at the 400 level or above and two laboratory courses with at least one at the 400 level. Biol 312, 303, and Gen 462 are also acceptable electives. A maximum of 4 credits of 490R and no credits of 490S and 490U may be used toward the 17 credits; however, only 2 credits of 490R may be applied to the requirement of seven 400 or above credits and no 490R credits can be applied to the laboratory requirement. The 17 credits must also include at least one organismal course.
3. Two years of chemistry or biochemistry totaling 15 credits to include one year of general chemistry with laboratory and at least one semester of organic chemistry with laboratory.
4. Eleven credits of calculus and statistics including at least one course in each.
5. One year of general college physics.
6. Majors in the College of Liberal Arts and Sciences must take one course that involves both humanities and biology such as history of science or bioethics. This course may also count toward a college group requirement. A list of acceptable courses is available in the department office.
7. Majors in the College of Agriculture must take 6 credits of agricultural biology electives. This requirement is satisfied by passing six credits at the 300 level or above from the departments of Animal Ecology, Animal Science, or Entomology.
8. Majors in the College of Agriculture must include Biol (A Ecl) 312 in their program.

Majors are encouraged to take advantage of special opportunities available in summer courses at the Iowa Lakeside Laboratory at Lake Okoboji and at the Gulf Coast Research Laboratory, Ocean Springs, Mississippi. (See *Index*.) Generally, these credits may be applied toward the zoology elective requirement. Interested students should consult their advisers.

The department offers a minor in zoology which may be earned by receiving credit for Biol 301, 301L, 302, 302L, Zool 355, and 3 additional zoology credits taken at the 300

level or above. A Zoology major may not double major or minor in Biology.

Information of the faculty, programs, staff and course requirements for the genetics or zoology major can be found at the Zoology and Genetics web site:
www.molebio.iastate.edu/hm/zghomepg.html

Graduate Study

The department offers work for the master of science and doctor of philosophy degrees with majors in ecology and evolutionary biology; genetics; molecular, cellular, and developmental biology; toxicology; and zoology. The department also participates in the immunobiology and neuroscience interdepartmental programs. All degrees require the completion of original research and a written thesis or dissertation. For further information about each major, see the appropriate catalog listing or write to the department.

Students entering any graduate major or program in the department need a sound background in the biological, physical, and mathematical sciences and must be committed to research. Applicants are required to submit Graduate Record Examination (GRE) scores for both the aptitude and the biology advanced tests.

A student majoring in zoology may specialize in animal behavior, cell biology, molecular biology, developmental biology, comparative physiology, ecology, endocrinology, immunobiology, neurobiology, parasitology, or physiology.

The requirements for the genetics major can be found under Genetics in the separate interdepartmental listing.

Specific course requirements for advanced degrees depend largely upon previous training and experience in the major area of specialization. There is no foreign language requirement. Certification in the use of written English is required. All graduate students must acquire teaching experience, usually in laboratory courses, as part of their graduate program. All graduate students will participate in a 690 journal club seminar and a 696 research seminar in their area of interest each academic year. Students majoring in an interdepartmental program may substitute one semester of program seminar requirement for 690/696 departmental seminar.

Courses open for nonmajor graduate credit: Zool 355, 403I, 415I, 419I, 428, 454, 456, 459, 462; Gen 410, 411, 460, 462.

Genetics (Gen)

Courses Primarily for Undergraduate Students

Gen 110. Genetics Orientation. (1-0) Cr. 0.5. F. First 8 weeks. Orientation to the area of genetics. For students considering a major in genetics. Specializations and career opportunities. Offered on a satisfactory-fail grading basis only.

Gen 260. Human Heredity and Society. (3-0) Cr. 3. F. *Prereq:* One semester of college biology or *Anthr 202*. A survey course in genetics for non-biology majors interested in heredity and its importance, and implications to self and society. Not recommended for those intending to take advanced courses in genetics. Credit for graduation will not be allowed for

more than one of the following: 260, 301, 320, Biol 301 and 301L and Agron 320.

Gen 298. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of department cooperative education coordinator; sophomore classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Gen 301. Principles of Genetics. (Same as Biol 301.) See *Biology*. Credit for graduation will not be allowed for more than one of the following: 260, 301, 320, Biol 301 and 301L and Agron 320.

Gen 301L. Principles of Genetics Laboratory. (Same as Biol 301L.) See *Biology*.

Gen 308. Biotechnology in Agriculture, Food, and Human Health. (Dual-listed with 508.) (3-0) Cr. 3. F. S. *Prereq:* Biol 201 and 202. Scientific principles and techniques in biotechnology. Products and applications in agriculture, food, and human health. Ethical, legal, and social implications of biotechnology. A research paper is required for graduate credit.

Gen 320. Genetics, Agriculture and Biotechnology. (Same as Agron 320.) (3-0) Cr. 3. F.S. *Prereq:* Biol 202. Transmission genetics with an emphasis on applications in agriculture, the structure and expression of the gene, how genes behave in populations and how recombinant DNA technology can be used to improve agriculture. Credit for graduation will not be allowed for more than one of the following: 260, 301, 320, Biol 301 and 301L and Agron 320.

Gen 340. Human Genetics. (3-0) Cr. 3. S. *Prereq:* Biol 301, Gen 301. Fundamental concepts and current issues of human genetics. Human chromosome analysis, pedigree analysis, gene mapping, the human genome project, sex determination, genetics of the immune system, genetics of cancer, gene therapy, the genetic basis of human diversity, eugenetics.

Gen 398. Cooperative Education. Cr. R. F.S.SS. *Prereq:* Permission of department cooperative education coordinator; junior classification. Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Gen 410. Transmission Genetics. (3-0) Cr. 3. F. *Prereq:* 301. The principles and practice of transmission genetics. The Mendelian concept of the gene, mutational analysis of gene function, linkage and gene mapping, genetic fine structure analysis, chromosomal aberrations, aneuploidy and polyploidy, extrachromosomal inheritance, analysis of genetic pathways, genetics of quantitative traits. Nonmajor graduate credit.

Gen 411. Molecular Genetics. (3-0) Cr. 3. S. *Prereq:* 301. The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes. Nonmajor graduate credit

Gen 460. Mathematical Genetics. (Dual-listed with 560.) (2-0) Cr. 2. S. *Prereq:* Knowledge of elementary algebra and 301 or 320. Probability theory and its application to Mendelian, population, and quantitative genetics. Nonmajor graduate credit

Gen 462. Evolutionary Genetics. (Dual-listed with 562: same as Zool 462.) (3-0) Cr. 3. S. *Prereq:* Biol 303. The genetic basis of evolutionary processes in higher organisms. The role of genetic variation in adaptation, natural selection, adaptive processes, and the influence of random processes on evolutionary change. Nonmajor graduate credit

Gen 490. Independent Study. Cr. arr. *Prereq:* 301, junior or senior classification, permission of instructor. Students in the College of Agriculture may use no more than 6 credits of Gen 490 toward the total of 128 credits required for graduation; students in the College of Liberal Arts and Sciences may use no more than 9 credits of Gen 490 toward graduation.
I. Iowa Lakeside Laboratory.
R. Genetics research. Cr. 1 to 5 each time taken.
S. Attendance and critique of genetics seminars.
Cr. 1. Offered on a satisfactory-fail grading basis only.

U. Laboratory teaching experience. For students registering to be undergraduate laboratory assistants. Cr. 1 to 2. Offered on a satisfactory-fail grading basis only.

Gen 491. Undergraduate Seminar. (1-0) Cr. 1. F. *Prereq: Junior classification.* The investigation of current issues in genetics. Graduate school and employment opportunities discussed. Practice in résumé writing and interview techniques. Required for majors in genetics.

Gen 498. Cooperative Education. Cr. R. F.S.S.S. *Prereq: Permission of department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Gen 508. Biotechnology in Agriculture, Food, and Human Health. (Dual-listed in 308.) (3-0) Cr. 3. F.S. *Prereq: Biol 201 and 202.* Scientific principles and techniques in biotechnology. Products and applications in agriculture, food, and human health. Ethical, legal, and social implications of biotechnology. A research paper is required for graduate credit.

Gen 510. Transmission Genetics. (3-0) Cr. 3. F. *Prereq: 301.* The principles and practice of transmission genetics. The Mendelian concept of the gene, mutational analysis of gene function, linkage and gene mapping, genetic fine structure analysis, chromosomal aberrations, aneuploidy and polyploidy, extrachromosomal inheritance, analysis of genetic pathways, genetics of quantitative traits.

Gen 511. Molecular Genetics. (Same as MCDB 511.) (3-0) Cr. 3. S. *Prereq: 301.* The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes.

Gen 512. Plant Growth and Development. (Same as Bot512.) See *Botany*.

Gen 520. Genetic Engineering. (Same as BBMB 520, MCDB 520.) (3-0) Cr. 3. F. *Prereq: 411 or BBMB 405.* Strategies and methods of gene cloning, restriction endonuclease mapping, southern hybridization, isolation and manipulation of plasmid DNA, and detection of specific genes in bacteria.

Gen 528. Concepts in Genetics and Cytogenetics: Their Development. (Same as Agron 528.) See *Agronomy*.

Gen 536. Genetic Statistics. (Same as Stat 536.) See *Statistics*.

Gen 537. Genetic Statistics. (Same as Stat 537.) See *Statistics*.

Gen 550. Population Genetics. (Same as An S 550.) See *Animal Science*.

Gen 560. Mathematical Genetics. (Dual-listed with 460.) (2-0) Cr. 2. S. *Prereq: Knowledge of elementary algebra and 301 or 320.* Probability theory and its application to Mendelian, population, and quantitative genetics.

Gen 562. Evolutionary Genetics. (Dual-listed with 462; same as Zool 562.) (3-0) Cr. 3. F. *Prereq: Biol 303.* Graduate study in conjunction with 462. The genetic basis of evolutionary processes in higher organisms. The role of genetic variation in adaptation, natural selection, adaptive processes, and the influence of random processes on evolutionary change.

Gen 590. Special Topics. Cr. 1 to 3. *Prereq: 301 or 320.*

Gen 594. Introduction to Computational Molecular Biology. (Same as Com S 594, Math 594.) (3-0) Cr. 3. S. *Prereq: Biol 301 and 302 or Math 304 and 307 (Math 317 may be used in place of 307) or Com S 311 and 330 or equivalent courses.* Introduction to the biological background and the algorithms used in sequence comparison and data base search, fragment assembly and physical mapping of DNA, building of phylogenetic trees, analysis of genome rearrangement, and molecular structure prediction.

Practice with some of the software commonly used for these problems.

Courses for Graduate Students

Gen 615. Molecular Immunology. (Same as BBMB 615.) See *Biochemistry, Biophysics and Molecular Biology*.

Gen 620. Advanced Molecular Genetics. (Same as Micro 620.) (2-0) Cr. 2. Alt. F., offered 1999. *Prereq: 511 or BBMB 405.* Detailed analysis of prokaryotic and some eucaryotic genetic material at the molecular level including: replication, transcription, repair, recombination, control of gene expression (bacterial and viral), and genetic engineering using restriction endonucleases.

Gen 630. Developmental Genetics. (Same as MCDB 630.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: 411 or 511 or BBMB 405.* Genetics of developmental processes; the molecular structure and function of developmental regulatory genes. Techniques of genetic analysis of developmental systems.

Gen 675. Nucleic Acid Structure and Function. (Same as BBMB 675.) See *Biochemistry, Biophysics and Molecular Biology*.

Gen 696. Seminar in Plant Physiology and Molecular Biology. (Same as Bot 696.) See *Botany*.

Gen 698. Seminar in Molecular, Cellular, and Developmental Biology. (Same as MCDB 698.) See *Molecular, Cellular, and Developmental Biology*.

Gen 699. Research.

Zoology (Zool)

Courses Primarily for Undergraduate Students

Zool 110. Zoology Orientation. (1-0) Cr. 0.5. F. First 8 weeks. Orientation to the area of zoology. For students considering a major in zoology. Specializations and career opportunities in the zoological sciences, including medically related professions. Offered on a satisfactory-fail grading basis only.

Zool 155. Basic Human Physiology and Anatomy. (3-0) Cr. 3. F.S.S.S. *Prereq: H.S. biology and chemistry or Biol 109 or 201; Biol 109 or 201 recommended.* The structure and functions of human organ systems.

Zool 156. Laboratory in Human Physiology and Anatomy. (1-3) Cr. 2. F.S.S.S. *Prereq: Credit or enrollment in 155.* Introduction to selected aspects of human anatomy and physiology through the use of models, specimens, and student conducted experiments. Materials fee.

Zool 258. Human Reproduction. (Same as W S 258.) (3-0) Cr. 3. Alt. F., offered 2000. *Prereq: 155 or Biol 109 or 201.* Anatomy and physiology of human reproductive systems, including fertility, pregnancy, and delivery.

Zool 298. Cooperative Education. Cr. R. F.S.S.S. *Prereq: Permission of the department cooperative education coordinator; sophomore classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Zool 301I. Iowa Natural History. (Same as la LL 301I.) See *Iowa Lakeside Laboratory*.

Zool 303. Biological Evolution. (Same as Biol 303.) See *Biology*.

Zool 304. Animal Behavior. (3-0) Cr. 3 or (3-3) Cr. 4. F. *Prereq: Biol 202.* Ethological and sociobiological approaches to animal behavior. Genetic and developmental aspects of behavior, biological rhythms, orientation (including navigation, migration), communication, and social behavior (mating, aggression, parental care). Laboratory techniques for observation, description and analysis of animal activities; independent projects. Materials fee.

Zool 310. Brain and Behavior. (Same as Psych 310.) See *Psychology*.

Zool 311. Introduction to Parasitology. (Same as Micro 311.) (3-3) Cr. 4. F. *Prereq: Biol 202.* Biology and host-parasite relationships of major groups of animal parasites, and techniques of diagnosing and studying parasites. Materials fee.

Zool 312I. Ecology. (Same as la LL 312I.) See *Iowa Lakeside Laboratory*.

Zool 320. Comparative Chordate Anatomy. (3-4) Cr. 5. F. *Prereq: Biol 202, junior classification.* The evolution of chordates as reflected in the anatomy of extinct and living forms. Lecture topics include the history and diversity of chordates; comparisons of anatomic structures among major groups, the adaptive significance of anatomic structures. Laboratory involves dissection of representative species. Materials fee.

Zool 322. Vertebrate Histology. (3-3) Cr. 4. S. *Prereq: Biol 202.* Microscopic structure of vertebrate tissues and organs, with an introduction to histological techniques. Materials fee.

Zool 334. Embryology. (2-0) Cr. 2. S. *Prereq: Biol 202.* Basic principles and processes of development. Descriptive, comparative, experimental, and analytical embryology.

Zool 334L. Embryology Laboratory. (0-3) Cr. 1. S. *Prereq: Credit or enrollment in 334.* Classical developmental anatomy of vertebrate embryos plus selected experiments on living embryos. Materials fee.

Zool 338. Pharmacology I: The Fundamentals. (Same as BMS 338.) See *Biomedical Sciences*.

Zool 339. Pharmacology II: Drugs and the Biological Systems. (Same as BMS 339.) See *Biomedical Sciences*.

Zool 355. Principles of Physiology. (3-4) Cr. 5. F.S. *Prereq: Biol 302.* Introduction to systemic functions with emphasis on vertebrates. Materials fee. Nonmajor graduate credit.

Zool 383. Women in Science and Engineering. (Same as W S 383.) (3-0) Cr. 3. Alt. F., offered 1999. *Prereq: A 200 level course in science, engineering or women's studies; Engl 105.* The interrelationships of women and science and engineering examined from historical, sociological, philosophical, and biological perspectives. Factors contributing to under-representation; feminist critiques of science; examination of successful strategies.

Zool 398. Cooperative Education. Cr. R. F.S.S.S. *Prereq: Permission of the department cooperative education coordinator; junior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Zool 403I. Evolution. (Same as la LL 403I.) See *Iowa Lakeside Laboratory*. Nonmajor graduate credit.

Zool 405. Invertebrate Biology. (Dual-listed with 505.) (3-0) Cr. 3 or (3-3) Cr. 4. F. *Prereq: Biol 302.* Emphasis on the evolution, development, behavior and physiology of members of invertebrate phyla. Laboratory experiments emphasize invertebrate development, behavior, and physiology. Materials Fee. Nonmajor graduate credit.

Zool 415I. Freshwater Invertebrates. (Same as la LL 415I.) See *Iowa Lakeside Laboratory*. Nonmajor graduate credit.

Zool 419I. Vertebrate Ecology and Evolution. (Same as la LL 419I.) See *Iowa Lakeside Laboratory*. Nonmajor graduate credit.

Zool 428. Cell Biology. (3-0) Cr. 3. S. *Prereq: Biol 302.* Biological organization and function at the cellular level. Emphasis on biomembranes. Nonmajor graduate credit.

Zool 433. Developmental Biology. (Dual-listed with 533.) (3-0) Cr. 3. F. *Prereq: Biol 302.* Experimental analysis of development in animal model systems. Emphasis given to cellular and molecular mechanisms driving developmental events.

Zool 454. General and Comparative Endocrinology. (Dual-listed with 554.) (3-0) Cr. 3 or (3-3) Cr. 4. S. *Prereq: 355 and Biol 302.* Chemical integration of vertebrate organisms. The structure, development, and evolution of the endocrine glands and the function and structure of their hormones. Laboratory techniques for studying hormonal phenomena. Laboratory experiments require animal surgery and involvement outside of scheduled class time. Materials fee. Nonmajor graduate credit.

Zool 456. Neurobiology. (Dual-listed with 556.) (3-0) Cr. 3 or (3-3) Cr. 4. F. *Prereq:* 310 or 355; *physics recommended; permission of instructor to enroll in lab.* Integration, coding, plasticity, and development in nervous systems. Materials fee. Nonmajor graduate credit.

Zool 459. Environmental Physiology. (Dual-listed with 559.) (3-0) Cr. 3 or (3-3) Cr. 4. F. *Prereq:* 355 or A Ecl 311; *physics recommended.* Physiological adaptations to the environment with an emphasis on vertebrates. Materials fee. Nonmajor graduate credit.

Zool 462. Evolutionary Genetics. (Dual-listed with 562; same as Gen 462.) See *Genetics*. Nonmajor graduate credit.

Zool 490. Independent Study. *Prereq:* 15 credits in zoological sciences; *permission of instructor.*

Students in the College of Agriculture may use no more than 6 credits of 490 toward the total of 128 credits required for graduation; students in the College of Liberal Arts and Sciences may use no more than 9 credits of 490 toward graduation.

I. Iowa Lakeside Laboratory.

R. Zoology research. Cr. 1 to 5 each time taken.

S. Attendance and critique of zoology seminars.

Cr. 1. Offered on a satisfactory-fail grading basis only.

U. Laboratory teaching experience. Cr. 1 to 2. For students registering to be undergraduate laboratory assistants. Offered on a satisfactory-fail grading basis only.

Zool 491. Undergraduate Seminar. Cr. 1. F. *Prereq:* *Junior classification.* The investigation of current issues in zoology. Graduate school and employment opportunities discussed. Practice in resume writing and interview techniques.

Zool 498. Cooperative Education. Cr. R. F.S.SS. *Prereq:* *Permission of the department cooperative education coordinator; senior classification.* Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses Primarily for Graduate Students, Open to Qualified Undergraduate Students

Zool 501. Principles of Toxicology. (Same as Tox 501, V Pth 501.) See *Toxicology* or *Veterinary Pathology*.

Zool 502. Methods of Toxicology. (Same as Tox 502, V Pth 502.) See *Toxicology* or *Veterinary Pathology*.

Zool 505. Invertebrate Biology. (Dual-listed with 405.) (3-0) Cr. 3 or (3-3) Cr. 4. F. *Prereq:* Biol 302. Emphasis on the evolution, development, behavior and physiology of members of invertebrate phyla. Laboratory experiments emphasize invertebrate development, behavior, and physiology. Materials fee.

Zool 507. Advanced Animal Behavior. (2-0) Cr. 2. Alt. S., offered 2001. *Prereq:* 304 or 355. Analysis of current research in animal behavior with emphasis on physiological or endocrine control mechanisms.

Zool 510. Histology and Pathology of Fish Diseases. (Same as A Ecl 510.) (2-3) Cr. 3. Alt. S., offered 2000. *Prereq:* *A course in vertebrate histology or ichthyology.* Histology of teleost fishes; pathogen biology and analysis of cell and tissue changes in the major teleost diseases. Materials fee.

Zool 511I. Field Parasitology. (Same as Ia LL 511I.) See *Iowa Lakeside Laboratory*.

Zool 515. Ecology of Freshwater Invertebrates. (Same as A Ecl 515.) See *Animal Ecology*.

Zool 528. Cellular Growth and Regulation. (Same as MCDB 528.) (3-0) Cr. 3. F. *Prereq:* *Courses in cell biology and biochemistry.* Cell cycle, regulation of cell growth, cell division, membranes, transport processes, and regulation of cellular activities.

Zool 533. Developmental Biology. (Dual-listed with 433; same as MCDB 533.) (3-0) Cr. 3. F. *Prereq:* Biol 302. Experimental analysis of development in animal model systems. Emphasis given to cellular and molecular mechanisms driving developmental events.

Zool 534. Developmental Mechanisms. (3-0) Cr. 3. Alt. S., offered 2000. *Prereq:* 533 and BBMB 404 or 420. Current research topics in cellular and molecular mechanisms of animal development and differentiation. Focus will be on primary research and new techniques. Complimentary course to Gen 630.

Zool 540. Signal Transduction. (Same as BBMB 540.) (3-0) Cr. 3. S. *Prereq:* 528, BBMB 404. Mechanisms and components of cellular signal transduction including receptors, G-proteins, second messengers, protein phosphorylation, other post-translational protein modifications, and transcriptional regulation.

Zool 542. Introduction to Molecular Biology Techniques. (Same as BBMB 542, Bot 542, FS HN 542, BMS 542.) Cr. 1 per module. F.S.SS. *Prereq:* *Graduate classification.* Workshops in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail grading basis only.

A. DNA Techniques. Includes genetic engineering procedures, sequencing, PCR, and genotyping.

B. Protein Technique. Includes fermentation, protein isolation and analysis, NMR and monoclonal antibody production.

C. Cell Techniques. Includes cell immobilization, ELISA, flow cytometry, karyotyping and image analysis.

D. Plant Transformation. Includes Agrobacterium and particle gun transformation, and analysis of transformants (enzyme assay, PCR, Southern blot).

Zool 554. General and Comparative Endocrinology. (Dual-listed with 454.) (3-0) Cr. 3 or (3-3) Cr. 4. S. *Prereq:* 355 and Biol 302. Graduate study in conjunction with 454. Chemical integration of vertebrate organisms. The structure, development, and evolution of the endocrine glands and the function and structure of their hormones. Laboratory techniques for studying hormonal phenomena. Laboratory experiments require animal surgery and involvement outside of scheduled class time. Materials fee.

Zool 556. Neurobiology. (Dual-listed with 456; same as Neuro 556.) (3-0) Cr. 3 or (3-3) Cr. 4. F. *Prereq:* 355 or 310; *physics recommended; permission of instructor to enroll in lab.* Graduate study in conjunction with 456. Integration, coding, plasticity, and development in nervous systems. Materials fee.

Zool 557. Advanced Neuroscience Techniques. (Same as Neuro 557.) See *Neuroscience*.

Zool 559. Environmental Physiology. (Dual-listed with 459.) (3-0) Cr. 3 or (3-3) Cr. 4. F. *Prereq:* 355 or A Ecl 311, *physics recommended.* Graduate study in conjunction with 459. Physiological adaptations to the environment with emphasis on vertebrates. Materials fee.

Zool 562. Evolutionary Genetics. (Dual-listed with 462; same as Gen 562.) See *Genetics*.

Zool 590. Special Topics. (Same as Ia LL 590I.) Cr. 1 to 5 each time taken. *Prereq:* *Permission of instructor.*

I. Iowa Lakeside Laboratory.

Courses for Graduate Students

Zool 632. Current Topics in Signal Transduction. Cr. 2 to 3 each time taken. *Prereq:* *Permission of instructor.* Selected topics in signal transduction events, their molecular mechanisms and their relation to cellular processes. Topics may include cell recognition, second messenger systems, information integration and transfer, cell cycle, cell differentiation, and pattern formation.

Zool 650. Current Topics in Physiology. Cr. 2 to 3 each time taken. *Prereq:* 355; *permission of instructor.* Topics from comparative physiology, environmental physiology, mammalian physiology, selected physiological techniques.

Zool 660. Current Topics in Neurobiology and Behavior. (Same as Neuro 660.) Cr. 2 to 3 each time taken. *Prereq:* *Permission of instructor.* Topics may include communication, hormones and behavior, neural integration, developmental neurobiology, neuroanatomy and ultrastructure, sensory biology, social behavior, techniques in neurobiology and behavior.

Zool 690. Seminar in Zoology. Cr. 1 each time taken. Journal article critique and discussion by faculty and graduate students. Offered on a satisfactory-fail grading basis only.

A. Cellular, Molecular, and Developmental Biology
B. Biology of Populations and Organisms
C. Neurobiology
D. Physiology
E. Evolution
F. Animal Models of Gene Therapy
G. Behavior

Zool 696. Research Seminar. Cr. 1 each time taken. Research seminars by faculty and graduate students. Offered on a satisfactory-fail grading basis only.

A. Cellular, Molecular, and Developmental Biology
B. Biology of Populations and Organisms
C. Neurobiology
D. Physiology
E. Evolution
F. Animal Models of Gene Therapy
G. Behavior

Zool 698. Seminar in Molecular, Cellular, and Developmental Biology. (Same as MCDB 698.) See *Molecular, Cellular, and Developmental Biology*.

Zool 699. Research.

I. Iowa Lakeside Laboratory.

Courses Offered at the Gulf Coast Research Laboratory (GCRL), Ocean Springs, Mississippi

The Gulf Coast Research Laboratory is affiliated with the University of Southern Mississippi. Iowa State students may register for the following University of Southern Mississippi/GCRL courses and transfer them to their ISU degree programs. Written permission of the ISU coordinator for the GCRL, 201 Bessey, is required for this arrangement. Inquire at 201 Bessey for further information.

MAR 301. Marine Biology. Cr. 3. SS. *Prereq:* 8 semester hours of biological sciences. A general introduction to marine biology with emphasis on local fauna and flora.

MAR 301L. Marine Biology Lab. Cr. 2. SS. Lab to accompany 301.

MAR 403. Marine Invertebrate Zoology. Cr. 3. SS. *Prereq:* 16 credits in zoology, including an introductory course in invertebrate zoology. Concentrated study of free-living, marine invertebrates of the Mississippi Sound and adjacent continental shelf of the north-eastern Gulf of Mexico. Emphasis on structure, classification, phylogeny, larval development, and functional processes.

MAR 403L. Marine Invertebrate Zoology Lab. Cr. 3. SS. Lab to accompany 403.

MAR 404. Parasites of Marine Animals. Cr. 3. SS. *Prereq:* 311. Study of the parasites of marine and estuarine animals with emphasis on morphology, taxonomy, life histories, and host-parasite relationships.

MAR 404L. Parasites of Marine Animals Lab. Cr. 3. SS. Lab to accompany 404.

MAR 408. Marine Ichthyology. Cr. 3. SS. *Prereq:* 16 credits in zoology, including comparative anatomy. Principles involved in classification and taxonomy of marine and estuarine fishes.

MAR 408L. Marine Ichthyology Lab. Cr. 3. SS. Lab to accompany 408.

MAR 430. Comparative Histology of Marine Organisms. Cr. 3. SS. *Prereq:* *Permission of instructor.* Detailed study of the histological organization of representative marine organisms at the light and electron microscope levels.

MAR 430L. Comparative Histology of Marine Animals Lab. Cr. 3. SS. Lab to accompany 430.

The Faculty

Distinguished Professor denotes those faculty members who have been recognized for having attained outstanding national and international reputations within their professional disciplines.

University Professor denotes those faculty members who have been recognized for having made outstanding contributions to the quality of education at Iowa State University.

ABBOTT, ERIC ALAN, Professor of Journalism and Communication. B.S., 1967, Iowa State; M.S., 1970, Ph.D., 1974, Wisconsin

ABELSON, ABRAHAM G., Professor of Curriculum and Instruction. B.A., 1964, M.Ed., 1970, Pennsylvania State; Ph.D., 1976, Michigan.

ABENDROTH, ROBERT E., Associate Professor of Civil Engineering. B.S., 1966, M.S., 1968, Ph.D., 1983, Wisconsin.

ABIAN, ALEXANDER, Emeritus Professor of Mathematics. B.S., 1946, Tehran; M.S., 1954, Chicago; Ph.D., 1956, Cincinnati.

ABOU-GABAL, MOUSTAFA, Associate Professor of Veterinary Microbiology and Preventive Medicine. B.V.Sc., 1962, Cairo; Dr.MedicineVet, 1970, Hanover.

ABRAHAM, LINUS, Assistant Professor of Journalism and Communication. B.A., 1992, M.A., 1997, Minnesota; Ph.D., 1998, Pennsylvania.

ABRAHAM, ROBERTA G., Emeritus Professor of English. B.A., 1953, Cornell; M.A., 1976, Iowa State; Ph.D., 1981, Illinois

ABRAHAM, WILLIAM H., Emeritus Professor of Chemical Engineering. B.Ch.E., 1952, Cornell; Ph.D., 1957, Purdue.

ACKER, DAVID G., Associate Professor of Agricultural Education and Studies. B.A., 1975, Wilmington; M.Ed., 1980, M.S., 1980, California (Davis); Ph.D., 1989, Oregon State.

ACKER, DUANE, Professor of Animal Science (Collaborator). B.S., 1952, M.S., 1953, Iowa State; Ph.D., 1957, Oklahoma State.

ACKERMAN, RALPH A., Professor of Zoology. B.A., 1967, Rutgers; Ph.D., 1975, Florida.

ACKERMANN, MARK R., Associate Professor of Veterinary Pathology. D.V.M., 1986, Ph.D., 1990, Iowa State.

ADAMS, DONALD R., Professor of Biomedical Sciences; University Professor. A.B., 1960, California (Davis); M.A., 1967, Chico State; Ph.D., 1970, California (Davis).

ADAMS, JEAN W., Professor of Economics. B.A., 1969, M.A., 1971, Ph.D., 1973, Illinois.

ADAMS, ROY DEAN, Professor of Economics. B.A., 1968, M.A., 1971, Ph.D., 1972, Illinois.

ADAMS, SAMUEL KEITH, Associate Professor of Industrial and Manufacturing Systems Engineering. B.Mgt.E., 1960, Rensselaer; M.S.E., 1962, Ph.D., 1966, Arizona State.

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The Index

A

Academic Advising 16, 37
Academic Calendar 3
Academic Dishonesty 41
Academic Dismissal 46
Academic Grievances 50
Academic Learning Lab 26
Academic Life 37
Academic Privileges and Opportunities 49
Academic Problems, Sources of Help With 49
Academic Progress 46, 47
Academic Progress, Financial Aid Recipients 48
Academic Regulations 41
Academic Renewal Policy 41, 48
Academic Standards 46
Academic Success Center (ASC) 26
AccessPlus Information System 37
Access to Student Records 50
Accounting 121
Accreditation, University 7
ACT Admission Requirement 8
Activity Fee 18
Addresses of Students 50
Administration of Iowa State University 7
Admission Procedures 8
 Continuing Education 16
 Graduate College 112
 Reentering Students 10
 Students Direct from High School 8
 Teacher Education Program 325
 Transfer Students 9
 Veterinary Medicine 109
When to Apply 8
Admission Requirements 8
Admissions and Registrar 8
Adult Learner and Commuter Student Programs, Office of 27
Adult Undergraduate Residence 23
Advanced Placement (AP) Program of the College Board 12
Advertising 239
Advisers for Areas of Specialization in Teacher Education 327
Advising, Academic 16
Advocacy 29
Aerospace Engineering 88, 122
Affirmative Action Policy 5
African American Studies 125
Agricultural Biochemistry 58
Agricultural and Biosystems Engineering 128
Agricultural Business 59

Agricultural Education 59
Agricultural Education and Studies 126
Agricultural Engineering 89, 128
Agricultural Extension Education 60
Agricultural Studies 60
Agricultural Systems Technology 61, 130
Agriculture and Home Economics Experiment Station 33
Agriculture and Natural Resources, Extension to 36
Agriculture, College of 57
Agronomy 61, 132
Airworthiness Assurance Center of Excellence 35
Air Force Aerospace Studies 136
Alcohol-free Houses 22
Alternative Loans 21
American Indian Studies 137
Ames Center for Animal Health 33
Ames Laboratory of the U.S. Department of Energy 35
Analog and Mixed Signal VLSI Design Center 34
Animal Ecology 62, 138
Animal Science 63, 140
Anthropology 143
AP (Advanced Placement) 10, 12
Apparel Merchandising, Design, and Production 99
Apartments 23
Appeal of Academic Grievances 50
Application Fee 18
Application for Admission 8
Archaeology/See Anthropology 143
Architecture 76, 145
Arranged Credit 120
Art - Teaching Specialization 326
Art and Design, B.A. 78
Art and Design, B.F.A., 77
Art and Design 148, 149
Art: Craft Design 150
Art: Drawing/Painting/Printmaking 150
Art Education 151
Art: Graphic Design 151
Art History 153
Art: Interior Design 152
Art: Visual Studies 154
Articulation/Transfer Agreements 10
Associate in Arts (AA) Articulation Agreement 10
Astronomy and Astrophysics 301
Athletic Training 85
Athletics 242
Attendance 39, 41

Auditing Courses 49
Automobiles on Campus 32

B

Bachelor of Arts - Performing Arts Major 332
Bachelor of Liberal Studies (BLS) 16
Bachelor's Degree Requirements 54
Bachelor's Degree, Two 43
Bacteriology 155
Bicycle Regulations 32
Biochemistry, Biophysics, and Molecular Biology 155
Biological/ Premedical Illustration 157
Biology 157
 Teaching Specialization 326
Biomedical Engineering 159
Biomedical Sciences 159
Biotechnology Council 34
Board of Regents 7
Botany 161
Bridge Engineering Center 34
Buchanan Hall 23
Business 73
Business, College of 72
Business Administration 163
Business and Industry, Extension to 36
Business Research Institute 36

C

Calendar 3
Campus Visits 8
Campus Visits, Orientation and New Student Days, Office of 13
Cancellation of Registration 39
Career Services Offices 25
Carrie Chapman Catt, Center for Women & Politics 34
Cars on Campus 32
Catalog in Effect 55
CBE 12
Cell Biology/See Molecular Biology
Center for Advanced Technology Development (CATD) 35
Center for Agricultural and Rural Development (CARD) 33
Center for Building Energy Research 34
Center for Coal and the Environment 35
Center for Crops Utilization Research 33
Center for Designing Foods to Improve Nutrition 34
Center for Family Policy 34
Center for Interfacial Materials and Crystallization 34
Center for Nondestructive Evaluation (CNDE) 35

- Center for Physical and Computational Mathematics 35
- Center for Rare-earths and Magnetics 35
- Center for Technology in Learning and Teaching 34
- Center for Transportation Research and Education 34
- Ceramic Engineering *See Materials Engineering* 276
- Certificate of Public Management 15
- CEU, Continuing Education Units 16
- Challenge and Review of Records 51
- Change of Schedule Fee 18
- Changing Curriculum or Major 44
- Changing a Grade 45
- Cheating, *See Academic Dishonesty* 41
- Chemical Engineering 90, 164
- Chemistry 166
- Teaching Specialization 327
- Child and Family Services, Curriculum in 99
- Child Care 30
- Child Development/*See Human Development and Family Studies*
- Chinese 224
- Civil Engineering 99, 169
- Class Attendance 41
- Classical Greek/ *See Greek*
- Classical Studies 174
- Classification of Residents 10
- Classification of a Student 42
- CLEP 12
- Clinical Laboratory Science/Medical Technology 308
- Co-ed Housing 22
- Co-listed Courses 120
- Coaching Interscholastic Athletics 242, 327
- College Level Examination Program (CLEP) 12
- College Research Institutes 36
- Colleges and Curricula 53
- Committee on Lectures 31
- Communication Disorders 312, 315, 320
- Communication Studies** 23, 319, 320
- Communities, Extension to 36
- Community and Regional Planning 78, 174
- Community College Induction/Mentoring (CCIM) Program 14
- Community Health Education 82
- Computation Center 34
- Computational Fluid Dynamics Center 34
- Computer Engineering 91, 177
- Computer Science 179
- Confidential Information 50
- Construction Engineering 92, 182
- Contact Hours 120
- Continuing Education, *See Extended and Continuing Education* 14
- Continuing Education Units 16
- Continuous Registration 114
- Correspondence Course Credit 10
- Costs, Fees 17
- Counseling Service, Student 24
- Counselor Education 194
- Course Designators 52
- Course Numbers 120
- Course Prerequisites 120
- Course-related Presentations, Ownership of 41
- Courses and Programs 120
- Craft Design 150
- Credit by Examination (CBE) 12, 49
- Credit, Definition of 120
- Credit Fee Schedule 17
- Credit for Military Service 10
- Credit Involving a Paid Activity 41
- Criminal Justice Studies 183
- Crop Science/ *See Agronomy*
- Cross-Cultural House 22
- Cross-Listed Courses 120
- Cumulative Grade Point Average 45
- Curricula 53
- Curriculum and Instruction 183, 184
- Curriculum Requirements 55
- Cytotechnology 308
- D**
- Dairy Science 63
- Dance 243
- Day Care 30
- Dead Week 45
- Dean's List 49
- Dean of Students Office 26
- Declaring a Minor 44
- Deferred Payment 17
- Deficiency, Quality Point 46
- Degree Planning 43
- Degree Requirements, Bachelor's 54
- Graduate College 115
- Dietetics 64, 100
- Dental Hygiene, Preprofessional Study 309
- Dentistry, Preprofessional Study 309
- Departmental Examinations 12
- Departmental Test-out Exams 12
- Design and Pattern Making/*See Textiles and Clothing*
- Design, College of 75
- Design Studies 188
- Designated Repeats 46
- Designators 52
- Developmental Math Fee 18
- Dietetics 64
- Disabilities, Services for Students with *See Student Support Services* 29
- Dishonesty, Academic 41
- Diversity, U.S. and International Perspective Requirements 54
- Dismissal, Academic 46
- Doctor of Philosophy 117
- Dormitories/*See Student Housing* 22
- Double Degrees 43, 54
- Double Major/Curriculum 43
- Dramatics 32
- Drawing/Painting/Printmaking 151
- Drop Limit 39
- Dual-degree Programs 55
- Dual-listed Courses 120
- E**
- Early Childhood Education 83, 100, 183
- Early Childhood Special Education/*See Special Education*
- Earth Sciences/*See Geological and Atmospheric Sciences* 232
- Ecology/*See Animal Ecology, Botany and Environmental Studies*
- Ecology and Evolutionary Biology 189
- Economics** 190
- Education, College of 81
- Educational Administration 195
- Educational Leadership and Policy Studies 194
- Electric Power Research Center 34
- Electrical Engineering 92, 198
- Elementary Education 83, 184
- Emergency Loans, University 21
- Employment, Part-time 21
- Employment, Student 21
- Enforcement of Course Prerequisites 39
- Engineering 232
- Engineering Centers 34
- Engineering, College of 87
- Engineering Mechanics 203
- Engineering Operations 93, 205
- Engineering Research Institute 36
- Engineering Science 94, 206
- English 207
- Teaching Specialization 327
- English as a Second Language, Teaching Specialization 327
- English Proficiency Policy 54
- English Requirement for International Students 54
- Enrollment in Courses 37
- Entomology 64, 212
- Entrepreneurial Studies 214
- Environmental Planning/*See Community and Regional Planning*
- Environmental Science 65, 215
- Environmental Studies 216
- Evaluation of Academic Progress 44
- Evening and Saturday Classes 56
- Examination, Credit by (CBE) 12, 49
- Examinations 44
- Examinations, Final 44-45
- Exchange Programs 56
- Exercise and Sport Science 84, 244
- Expenses 17
- Extended and Continuing Education 14, 36

Extension, University 36

F

Facts 11

Faculty Listing 347

Families, Extension to 36

Family and Consumer Sciences, College of 97

Family and Consumer Sciences Education and Studies 100, 217

Family and Consumer Sciences, Master of 217

Family and Consumer Sciences Research Institute 36

Family Resource Management and Consumer Sciences, Curriculum in 101

Farm Operation/See Agricultural Education and Studies

Federal Cooperative Education Program 55

Federal Direct PLUS Loan 21

Federal Direct Stafford Loan 21

Federal Health Professions Loan and Scholarships 21

Federal Pell Grant 20

Federal Perkins Loan 20

Federal Supplemental Educational Opportunity Grant 20

Fee Payment 17

Fee Schedule Per Credit 17

Fees 18, 20

Fees and Expenses 17

Field Trips 41

Final Exams 44-45

Finance 219

Financial Aid 20

Financial Aid, Satisfactory Academic Progress for 48

Financial and Credit Transfer 56

Food Safety Consortium 33

Food Science 102

Food Science and Technology-B.S./M.S 102

Food Science and Technology-B.S./M.S., Curriculum in 66

Food Science, Curriculum in 65

Food Science and Human Nutrition 220

Foreign Language Placement 12

Foreign Languages 229

Foreign Languages and Literatures 224

Forensics 30

Forestry 66, 229

Fraternalities and Sororities 23

French 225

Teaching Specialization 327

Freshman Honors Program 55

G

General Education Requirement, *See information for each College*

Genetics 66, 343, 344

Genetics - Interdisciplinary 232

Geographical Information Systems (GIS)

Facility 34

Geological and Atmospheric Sciences 232

Geology 233

German 225

Gerontology 236

Gift Aid 20

Grade Change 45

Grade Point Average 45

Grade Posting 51

Grades, Release of 51

Grading System 45

Graduate Area of Specialization

Graduate College 112

Graduate Majors, Summary of 108

Graduate Programs 112

Graduate Residence Hall 23

Graduate Studies 237

Graduate Study 112

Graduation Fee 18

Graduation Requirements/See also individual departments

Graduation with Distinction 49

Graduate and Adult Undergraduate Residence Halls 23

Graduation 44

Grants 20

Graphic Design 79, 151

Greek 226

Greek Affairs 27

Greek Houses/See Fraternities and Sororities

Greenlee School of Journalism and Communication 237

Grievances, Academic 50

Gulf Coast Research Laboratory 55, 158, 163, 236, 241, 289

H

Health and Human Performance 241

Health Center 24

Health Education, Teaching Specialization 328

Health Fee 18

Health Information Management, Preprofessional Study 309

Health, Premedical and Preprofessional Programs/See *Preprofessional Study* 309

Health Professions Loans and Scholarships 21

Health Studies 242

Help with Academic Problems 49

High School Preparation Required for Admission 9

High School Requirements, Unmet 47

Higher Education 196

Historical, Philosophical, and Comparative Studies in Education 197

History 246

Teaching Specialization 328

History of the University 6

Honor Societies 30

Honors House 22

Honors Program 55, 250

Horticulture 67, 251

Hospital and Health Administration 309

Hotel, Restaurant, and Institution Management 102, 253

Housing and the Near Environment 103

Housing (Interdepartmental Graduate Minor) 255

Housing, Student 22

Human Development and Family Studies 255

Human Medicine, Preprofessional Study 309

I

Identification Number 51

Immunobiology 259

Incomplete Coursework 45

Independent Study 49

Industrial Engineering 94, 260

Industrial Relations 263

Industrial Relations Center 35

Industrial Technology 85, 262

Institute for Design Research and Outreach 36

Institute for International Cooperation in Animal Biologics 35

Institute for Physical Research and Technology 35

Institute for Social and Behavioral Research 33

Intensive English and Orientation Program (IEOP) 10

Interdepartmental Programs 121

Interdisciplinary Graduate Studies 265

Interdisciplinary Studies (undergraduate) 265

Inter-institutional Programs 55

Interior Design 79, 152

International Agriculture 68, 265

International Baccalaureate Examinations 12

International Business 266

International Educational Services 25

International Institute of Theoretical and Applied Physics 35

International Students and Scholars, Office of 20

International Students, English Requirement for 54

International Studies Program 266

Internships 21, 56

Interpersonal and Rhetorical Communication 319, 320

Intramural Program/See *Recreation Services* 28

Iowa Beef Center 33

Iowa Center for Emerging Manufacturing Technology (ICEMT) 35

Iowa Energy Center 35

Iowa Grant 20

Iowa Lakeside Laboratory 55, 267

Iowa Minority Grant for Economic Success (IMAGES) 20

Iowa Regents' Universities Articulation Agreement 10

Iowa Space Grant Consortium 35
Iowa State University Industrial Assessment
Center 34
ISUCard and Identification Number 51
Italian 226

J

Journalism and Mass Communication,
Greenlee School of 239
Judicial Affairs 27

L

Lakeside Laboratory/See Iowa Lakeside
Laboratory
Land Grant University 4
Landscape Architecture 26, 80
Language Programs 56
Languages/See Foreign Languages and
Literatures
Late Afternoon, Evening, and
Saturday Classes 56
Late Fee Payment 18
Late Registration Fee 18
Latin 226
Teaching Specialization 327
Latino/a Studies 271
Law, Preprofessional Study 309
Learning Communities 37
Learning Disabilities/See Curriculum
and Instruction
Learning Lab 26
Lectures 31
Legal Services 29
Leopold Center for Sustainable Agriculture 33
Lesbian Gay Bisexual Transgender Student
Services (LGBTSS) 27
Liberal Arts and Sciences, College of 104
Liberal Arts and Sciences Cross-Disciplinary
Studies 271
Liberal Arts and Sciences, Curriculum in 105
Liberal Studies 108
Library 272
Library, University 24
Library and Information Science 309
Library Requirement 54
Library Study 54
Licensure, Teacher
Linguistics 272
Loans 20

Master of Agriculture 14

Master of Education in Educational
Leadership 14
Master of Engineering in Systems
Engineering 15
Master of Family and Consumer Sciences 217
Master of Science in Computer
Engineering 15
Master of Science in Electrical Engineering 15
Master of Science in Microbiology 15
Materials Engineering 95, 276
Materials Preparation Center 35
Materials Science and Engineering 278
Mathematics 279
Teaching Specialization 328
Matriculation Fee 18
Meal Plans 22
Meat Export Research Center 33
Mechanical Engineering 95, 284
Memorial Union 32
Meteorology 235, 287
Microbiology 68, 287
Microelectronics Research Center 35
Midterm Grades 45
Midwest Agribusiness Trade Research and
Information Center (MATRIC) 33
Military Credit 10
Military Science 290
Military Service, Credit for 10
Military Training 56
Minority Student Affairs, Office of 25
Minors 54
Minor, Declaring 44
Minority Student Affairs, Office of 25
Minors Requirements *See also Colleges*
Molecular, Cellular, and Developmental
Biology 291
Motor Vehicles and Bicycles 32
Music 107, 292
Music Activities 32
Music Instruction Fees 17

N

National Soil Tilth Laboratory 35
Naval Science 295
Neuroscience 296
Nondiscrimination Policy and Affirmative
Action Policy 5
Nonmajor Graduate Credit 121
Nonresident Students, Classification of 10
Nonthesis Degrees, M.S., M.A. 116
North Central Regional Aquaculture Center 33
North Central Regional Center for Rural
Development 33
North Central Regional Plant Introduction
Station 33
Nuclear Medicine Technology, Preprofessional
Study 309
Nursing, Preprofessional Study 309
Nutrition B.S./M.S. 103
Nutritional Science 103

Nutritional Science, Curriculum in 69
Nutrition-B.S./M.S., Curriculum in 69
Nutritional Sciences Council 33

O

Occupational Therapy, Preprofessional Study
309
Off-Campus Credit Courses and Programs 14
Off-Campus Employment 21
Off-Campus Housing for Students 23
Office of Admissions 8
Office of Adult Learner and Commuter Student
Programs 27
Office of International Students
and Scholars 25
Office of Minority Student Affairs 25
Office of the Registrar 8
Officer Education Programs 296
Optometry, Preprofessional Study 310
Organizational Learning and Human Resource
Development 197
Organizations, Student 28
Orientation 13
Orientation, Summer 12
Outdoor Recreation 28
Ownership of Course-related Presentations 41

P

Parents Association (ISUPA) 28
Part-time Employment 21
Pass-Not Pass Grading 49
Past Due Accounts 17
Pathology/See Plant Pathology and Veterinary
Pathology
Payment of Fees 17, 38
Pell Grant 20
Performing Arts 333
Perkins Loan 20
Pest Management 69, 296
Pharmacology/See Veterinary Physiology and
Pharmacology
Ph.D. Requirements 117
Philosophy 297
Philosophy and Religious Studies 297
Physical Education/See Health and Human
Performance 243
Physical Education Licensure 328
Physical Sciences,
Teaching Specialization 328
Physics 301
Teaching Specialization 328
Physics and Astronomy 300
Physiology/See Animal Ecology, Animal
Science, Botany, Plant Pathology, Veterinary
Anatomy, Veterinary Physiology and
Pharmacology and Zoology and Genetics
Placement Offices 25
Plagiarism 42
Plant Breeding
Plant Health and Protection 303
Plant Pathology 304

- Plant Physiology 305
 - PLUS Loan 21
 - Policies and Procedures
 - Governing CBE Tests 13
 - Policy on Student Names 51
 - Political Science 305
 - Teaching Specialization
 - Portuguese 227
 - Postdoctoral Study 112
 - Posting Grades and Test Scores 51
 - Preliminary Exams (Ph.D.) 118
 - Premedical and Preprofessional Health Programs/See *Preprofessional Study* 309
 - Preprofessional Study 309
 - Prerequisites 39
 - Preventive Medicine/See Microbiology, Immunology and Preventive Medicine
 - Preveterinary Medicine 109
 - Priority Enrollment 120
 - Private Music Instruction 17
 - Production/ Operations Management 312
 - Professional Agriculture 70, 312
 - Professional Agriculture
 - Bachelor of Science 14
 - Professional Teacher Education
 - Requirement 326
 - Program of Study Committee, Graduate 115
 - Progressing Toward a Degree 42
 - Provisional Admission Status, Graduate 113
 - Psychology 313
 - Public Information 50
 - Public Relations/See Greenlee School of Journalism and Communication 237
 - Public Service and Administration in Agriculture 70, 316
- Q**
- Quality Point Deficiency 46
 - Quality Points 46
 - Quiet House 22
- R**
- Reading, Teaching Specialization 328
 - Recognition, Scholastic 49
 - Recording and Transmission of Classes 41
 - Records, Retention 50
 - Records, Withholding 51
 - Records, Review and Challenge 51
 - Records, Student 50
 - Recreation Services 28
 - Reentry 40
 - Refund of Room and Board Fees 40
 - Refunds 19
 - Regents 7
 - Regents' Articulation Agreement 10
 - Regents' Semester In Wales 56
 - Regents' Universities Student Exchange Program 55
 - Regional Planning/See Community and Regional Planning 174
 - Registration 12, 37
 - Registration, Cancellation 39
 - Registration Fee, Late 18
 - Registration Fee Schedule 17
 - Regulations, Academic 41
 - Reinstatement 47
 - Release of Grades 51
 - Religious Life 32
 - Religious Studies 297
 - Removal of Unmet High School Requirements 47
 - Repeating a Course 46
 - Required Credit 120
 - Requirements for Areas of Specialization in Teacher Education 325
 - Research and Evaluation 198
 - Research Institute for Studies in Education (RISE) 36
 - Research Organizations 33
 - Reserve Officer Training Corps (ROTC)/See Military Science 290
 - Residence Halls 22-23
 - Residency Guidelines 10
 - Restricted Admission Status, Graduate 113
 - Retention of Records 44
 - Returning or Reentry to the University 10, 40
 - Review and Challenge of Records 51
 - ROTC Scholarships 20
 - Room and Board, Refund of Fees 40
 - Russian 227
- S**
- SAT, Admission Requirement 8
 - Satisfactory Academic Progress for Financial Aid Recipients 48
 - Saturday and Evening Classes 56
 - Schedule Change Fee 18
 - Schedule Changes, Making 39
 - Scholarships 20
 - Scholastic Recognition 49
 - School Mathematics, Master of
 - Second Major 43
 - Secondary Education 184
 - Seed Science 71
 - Seed Science Center 33
 - Semester Calendar 3
 - Semester of Offering
 - Senior Fee 18
 - SEOG Grant 20
 - Smoke-free Houses 22
 - Social Security Numbers 51
 - Sociology 316
 - Sororities 23
 - Spanish 228
 - Special Course Fees 120
 - Special Education 187
 - Special Programs 55
 - Speech Communication 320, 329
 - Education 319
 - Speech-Language Pathology and Audiology 310
 - Sponsored International Student Fee 18
 - Stafford Loans 21
 - State Board of Regents 7
 - Statistical Laboratory 36
 - Statistics 322
 - Student Activities Center (SAC) 28
 - Student Apartments 23
 - Student Appeal, Academic Status 47
 - Student Counseling Service 24
 - Student Exchange Program, Regent Universities 55
 - Student Financial Aid 20
 - Student Health Center 24
 - Student Health Fee 19
 - Student Housing 22
 - Student-Initiated Withdrawal 40
 - Student Legal Services (SLS) 29
 - Student Life 30
 - Student Names, Policy on 51
 - Student Activities Center 28
 - Student Records (public and confidential) 50
 - Student Services 24
 - Student Support Services Program 29
 - Student Teaching 325
 - Students, Dean of 26
 - Study Abroad 56
 - Summer Camp Fee 19
 - Summer Orientation 12
 - Summer Study Abroad 56
 - Superintendency Certification Program (Certificate of Advanced Studies) 14
 - Supplemental Educational Opportunity Grants 20
 - Support Services Program, Student 29
 - Systems Engineering 325
- T**
- Teacher Education 325
 - Teacher Licensure 325
 - Teaching English to Speakers of Other Languages/See English
 - Technology and Social Change 329
 - Temporary Enrollment Status and Academic Dismissal 46
 - Test of English as a Foreign Language (TOEFL) 9
 - Test-Out/See Credit by Examination 12
 - Textiles and Clothing 330
 - Theatre 321, 333
 - Theatre and Dramatics 32
 - Theatre and Performing Arts 332
 - Theology or Religious Studies 310
 - TOEFL, Test of English as a Foreign Language 9
 - Touch-tone Registration 37
 - To withdraw from the university 40
 - Town Planning/See Community and Regional Planning 174

Toxicology 333
 Transcript Fee 19
 Transfer Agreements 10
 Transfer Credit Practices, Policies 9, 10
 Transfer of Credits 43
 Transfer Students 9
 Transportation 334
 Transportation and Logistics 335
 Tuition 17
 Tuition Assistance Grant for Undergraduate Foreign Students 20
 Tutoring Services 26
 Twelve-Month Payment Plan 17
 Two Bachelor's Degrees 43
 Types of CBE Programs 12

U

U.S. Diversity and International Perspective Requirements 54
 Undergraduate and Professional Degree Programs 53
 Undergraduate Admission into Degree Programs by Transfer from Other Educational Institutions 9
 Undergraduate Admission into Degree Programs Directly from High School 8
 Undergraduate Residence Halls 22
 University 4
 University Calendar 3
 University Emergency Loans 21
 University Extension 36
 University History 6
 University Long-Term Loan 21
 University Mission, Role, Scope 4
 University Points of Pride 5
 University Strategic Plan 6
 University Student Apartments 23
 University Student Employment 21
 University Studies 336
 University-Initiated Withdrawal 40
 Unmet High School Requirements, Removal 47
 Urban Planning/See Community and Regional Planning 174
 Utilization Center for Agricultural Products 33

V

Validation of Enrollment 39
 Vehicles on Campus 32
 Veteran Attendance 41
 Veterinary Clinical Sciences 336
 Veterinary Diagnostic Lab 36
 Veterinary Diagnostic and Production Animal Medicine 337
 Veterinary Medical Research Institute 36
 Veterinary Medicine 110, 310, 339
 Veterinary Medicine, College of 109
 Veterinary Microbiology & Preventive Medicine 339
 Veterinary Pathology 340

Visits to the Campus 8
 Visual Studies 154
 Vocational Rehabilitation Services 29
 Vocational-Technical Education/See Industrial Technology 262
 Vocational Technical Education/See Industrial Technology 198

W

Washington Center Program 55
 Water Resources 342
 Water Resources Research Institute 36
 WelcomeFest 13
 Wildlife Biology/See Animal Ecology 138
 William D. Ford Federal Direct Loan 21
 Withdrawal
 Student Initiated 40
 University initiated 40
 Withdrawal and Reentry 39
 Withdrawal from the University 40
 Withholding Records 51
 Women's Center, Margaret Sloss 27
 Women's Studies 342
 Work-Study Program 21
 Workshops, Fee 19
 Workshops, Refunds 19

Y-Z

Youth and 4-H, Extension to 36
 Zoology 71, 343, 345
 Zoology and Genetics 343