

# College of Engineering

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## Aligning Education in Engineering with the University Mission

The mission of Iowa State University is to create, share, and apply knowledge to make Iowa and the world a better place. Students will become broadly educated, global citizens who are culturally informed, technologically adept, and ready to lead. The College of Engineering echoes this philosophy and emphasizes preparing its graduates to meet the challenges of the 21st century.

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 at state, national and global levels.

The focus of each curriculum is to strengthen students' critical thinking, creative abilities, and communication skills. Students in engineering will have the opportunity for interdisciplinary and experiential learning through learning communities, service learning, internships and cooperative education, as well as research, capstone, and study abroad experiences.

The problem-solving skills learned from an engineering education at Iowa State University also provide an excellent launching pad for careers not only in engineering, but also medicine, law, business, and many other fields.

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 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.

## Concurrent Graduate/ Undergraduate Programs

Several engineering programs offer the opportunity for well-qualified undergraduate juniors and seniors to pursue a graduate degree in their program while finishing the undergraduate requirements. The programs offering concurrent undergraduate/graduate degrees are: aerospace engineering, agricultural engineering, biological systems engineering, chemical engineering, civil engineering, computer engineering, electrical engineering, industrial engineering, materials engineering, and mechanical engineering.

Programs offering concurrent bachelor of science/master of business administration degrees are: aerospace engineering, agricultural engineering, biological systems engineering, civil engineering, computer engineering, electrical engineering, industrial engineering and mechanical engineering. For more information, refer to the graduate study sections for each engineering program. Advanced work in engineering is offered in the post-graduate programs. See the Graduate College section of this catalog.

## Joint Undergraduate Programs

A bachelor of science degree in software engineering is offered in the College of Engineering and the College of Liberal Arts and Sciences. This program is jointly administered by the Department of Electrical and Computer Engineering and the Department of Computer Science.

## Accreditation

Twelve undergraduate engineering programs are accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>. These twelve programs are: aerospace, agricultural, biological systems, chemical, civil, computer, construction, electrical, industrial, materials, mechanical and software engineering.

Accreditation status is indicated in the Courses and Programs section for each engineering program.

## 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 should complete the requirements of the basic program before proceeding to a professional program.

## Preparation for the Engineering Curricula

In addition to the standard university admission requirements, the college also requires 2 years of a foreign language. Other high school credits particularly important to students wishing to study engineering include:

- 2 years of algebra,
- 1 year of geometry
- 1/2 year of trigonometry
- 1/2 year of pre-calculus
- 1 year each of chemistry, biology, and physics
- 3 years of social science
- 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.

## Requirement for Entry into Professional Program

Students enrolled in the College of Engineering must satisfy 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 minimum grade point average of 2.00 in the basic program courses.
2. A minimum grade point average of 2.00 for all courses taken at Iowa State University.
3. The College of Engineering requires a grade of C or better for any transfer credit course that is applied to the Basic Program.

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 three 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.
- 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 three basic program requirements may also enroll for not more than two semesters in 200-level or above courses offered by departments in the College of Engineering. However, they may be granted an additional semester upon review by the college.
- 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, students 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 semester credits.

## Engineering Minors

The College of Engineering offers four undergraduate minors which are open only to students in the College of Engineering. These are minors in biomedical engineering, energy systems, engineering sales and nondestructive evaluation. These minors must include at least nine credits which are beyond the total used to meet curriculum requirements.

The biomedical engineering minor is a 16 credit interdisciplinary program that complements a student's major discipline by providing additional insight into the interactions between various engineering disciplines and Biological systems. The minor is administered by a supervisory faculty committee. For minor course requirements, refer to Biomedical Engineering in Courses and Programs.

The energy systems minor is a 15 credit program that provides engineering students with focused educational opportunities in the broad area of energy systems. Students will understand broad energy perspectives, the language of energy systems and the economic, environmental, and policy issues related to energy. The minor is administered by a supervisory faculty committee. For minor course requirements, refer to Energy Systems in Courses and Programs or see <http://www.me.iastate.edu/energy-systems-minor/> .

The engineering sales minor is a 15 credit minor that complements the technical training in the student's major discipline by providing the tools and knowledge required for technical (i.e. business-to-business) sales careers. The minor is administered by a supervisory faculty committee. For minor course requirements, refer to Engineering Sales in Courses and Programs.

The nondestructive evaluation minor (16 credit minimum) open to engineering students who have met the basic program requirements and are not on academic warning or probation. The minor is supervised by an inter-disciplinary Engineering faculty committee. For minor course requirements, refer to Nondestructive Evaluation Engineering in Courses and Programs.

## Engineering Minor (Interdisciplinary)

The College of Engineering offers undergraduate minors in wind energy and nuclear engineering which are open to all students at ISU who meet the prerequisites. The wind energy minor is a 15 credit minor which enables students to acquire an interdisciplinary knowledge of the wind energy industry. There are two required courses; the remaining credits are chosen from a list of elective courses that are related to wind energy. The minor is administered by a supervisory faculty committee from several departments. For minor course requirements, refer to Wind Energy Minor in Courses and Programs. The nuclear engineering minor is a 15 credit minor which enables engineering students to acquire a basic and fundamental knowledge of nuclear sciences and engineering. Courses are provided at Iowa State University and also transfer courses that have been evaluated as substitutes for ISU courses may be used toward the minor. For minor course requirements, refer to Nuclear Engineering in Courses and Programs.

## 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 provide a resource contact person for 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. Transfer students may also complete orientation online. All entering students are encouraged to attend orientation which includes meeting with an academic adviser to register for classes. Placement assessments given during the orientation program help determine the student's current level of proficiency which enables the academic adviser to prepare an appropriate course schedule for the student.

## Special Programs

All engineering students are strongly encouraged to participate in either the cooperative education or internship programs. Students who are qualified to participate in the engineering honors program are also urged to do so. These programs are integrated into the professional engineering curricula and may require additional work. However, both these professional and academic programs offer opportunities that will enrich the standard academic experience. Engineering students are also encouraged to take advantage of study abroad opportunities available through the College of Engineering's International Programs Office.

a. Cooperative Education Program. The College of Engineering offers, through its curricula, an experiential education program. Enrollment in the program allows students to gain practical work 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 tuition or 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. The College of Engineering offers, through its curricula, an experiential education program. Internships are a mechanism by which a student may work full-time for one semester per academic year while maintaining her/his status as a full-time student. Enrollment in the program allows students to gain practical work experience in their career field while attending college. In general, students enrolled in the internship program will require an additional semester to complete curriculum requirements.

Internship students pay no tuition or fees to the university during their work periods and do not receive credit hours for their work experience. Students who register for the internship course (397) for a fall or spring semester work period or (396) for the summer term 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 ). 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.

d. Engineering International Engagement. In a world where the sun never sets, engineers must be prepared to understand other cultures and other ways of doing business. Engineers must expand their exportable skills, language and cross-cultural skills.

The College of Engineering has formed worldwide partnerships to create opportunities for students to work and study with leading universities in other countries and multinational corporations. With careful planning, students may earn credit in courses that fulfill their degree requirements. To learn more about work and study abroad, visit the Engineering International Engagement website: <http://www.engineering.iastate.edu/studyabroad/>

## Departments of the College

For information on undergraduate options refer to the following curriculum sections, and for graduate specializations or certificate programs, refer to the Courses and Programs section of the catalog.

- Aerospace Engineering
- Agricultural and Biosystems Engineering
- Chemical and Biological Engineering
- Civil, Construction and Environmental Engineering
- Electrical and Computer Engineering
- Industrial and Manufacturing Systems Engineering
- Materials Science and Engineering
- Mechanical Engineering

## Degree Programs

Aerospace Engineering  
Agricultural Engineering  
Biological Systems Engineering

Chemical Engineering  
 Civil Engineering  
 Computer Engineering  
 Construction Engineering  
 Electrical Engineering  
 Engineering Mechanics  
 Industrial Engineering  
 Information Assurance  
 Materials Engineering  
 Materials Science and Engineering  
 Mechanical Engineering  
 Software Engineering  
 Systems Engineering

## Minors

Biomedical Engineering  
 Energy Systems  
 Engineering Sales  
 Non-Destructive Evaluation Engineering  
 Nuclear Engineering  
 Wind Energy

## Engineering

Engineering

### Basic Program for Professional Engineering Curricula

The first year program is much the same for all professional curricula in the College of Engineering. Students normally enroll in the majority of the basic program courses during their first year. The basic program is a set of courses common to all engineering curricula. Since students may also begin curriculum designated requirements during their first year, they will want to select a curriculum as soon as possible. This will enable them to receive the bachelor's degree in a minimum time.

Entering undergraduates must demonstrate proficiency in trigonometry based on test scores, or by having transfer credits from a college trigonometry course, or by passing MATH 143 Preparation for Calculus before enrolling in MATH 166 Calculus II.

The Department of English may recommend placement in one or more sections of ENGL 099 or ENGL 101 English for Native Speakers of Other Languages if the placement test administered to students whose first language is not English indicates deficiencies. Satisfactory completion of the recommended English course(s) will be required of students to complete their Basic Program.

#### Basic Program

**(A minimum GPA of 2.00 required for this set of courses, including any transfer courses).**

|  |  |   |
|--|--|---|
| MATH 165                                       | Calculus I   | 4 |
| MATH 166                                       | Calculus II  | 4 |
| ENGL 150                                       | Critical Thinking and Communication                                  | 3 |
| ENGL 250                                       | Written, Oral, Visual, and Electronic Composition                    | 3 |
| CHEM 167                                       | General Chemistry for Engineering Students *                         | 4 |
| or CHEM 177                                    | General Chemistry I  |   |
| PHYS 221                                       | Introduction to Classical Physics I                                  | 5 |
| ENGR 101                                       | Engineering Orientation ***  | R |
| LIB 160  | Information Literacy   | 1 |
| ENGR 160                                       | Engineering Problems with Computer Applications Laboratory           | 3 |
| Or one of the following in place of ENGR 160** |  |   |
| AER E 160                                      | Aerospace Engineering Problems With Computer Applications Laboratory |   |
| A B E 160                                      | Systematic Problem Solving and Computer Programming                  |   |
| C E 160  | Engineering Problems with Computational Laboratory                   |   |
| CH E 160                                       | Chemical Engineering Problems with Computer Applications Laboratory  |   |
| CPR E 185                                      | Introduction to Computer Engineering and Problem Solving I           |   |
| E E 185  | Introduction to Electrical Engineering and Problem-Solving I         |   |

|         |   |  |
|---------|---|--|
| I E 148 | Information Engineering   |  |
| M E 160 | Mechanical Engineering Problem Solving with Computer Applications |  |
| S E 185 | Problem Solving in Software Engineering                           |  |

**Total Credits** 27

ENGL 250 Written, Oral, Visual, and Electronic Composition is normally taken in the second year. However, students who advance place into this course may be able to enroll during their first year. Credit for ENGL 150 Critical Thinking and Communication is earned upon successful completion of ENGL 250 Written, Oral, Visual, and Electronic Composition, but only when ENGL 250 Written, Oral, Visual, and Electronic Composition is completed at Iowa State. In addition to the basic program courses listed above, curriculum designated courses normally taken the first year of each engineering curricula are listed below.

#### Curriculum Designated Requirements

##### Aerospace Engineering

|                 |  |   |
|-----------------|--|---|
| AER E 161       | Numerical, Graphical and Laboratory Techniques for Aerospace Engineering | 3 |
| AER E 192       | Aerospace Seminar  | R |
| GenEd Electives |  | 3 |

##### Agricultural Engineering

|              |  |   |
|--------------|--|---|
| CHEM 167L    | Laboratory in General Chemistry for Engineering      | 1 |
| A B E 110    | Experiencing Agricultural and Biosystems Engineering | 1 |
| A B E 170    | Engineering Graphics and Introductory Design         | 3 |
| SSH Elective |  | 3 |

##### Biological Systems Engineering

|              |  |   |
|--------------|--|---|
| CHEM 167L    | Laboratory in General Chemistry for Engineering      | 1 |
| A B E 110    | Experiencing Agricultural and Biosystems Engineering | 1 |
| A B E 170    | Engineering Graphics and Introductory Design         | 3 |
| SSH Elective |  | 3 |

##### Chemical Engineering

|              |                                    |   |
|--------------|------------------------------------|---|
| CHEM 177     | General Chemistry I *              | 4 |
| CHEM 177L    | Laboratory in General Chemistry I  | 1 |
| CHEM 178     | General Chemistry II               | 3 |
| CHEM 178L    | Laboratory in College Chemistry II | 1 |
| SSH Elective |                                    | 3 |

##### Civil Engineering

|              |  |   |
|--------------|--|---|
| CHEM 177     | General Chemistry I *                            | 4 |
| CHEM 177L    | Laboratory in General Chemistry I                | 1 |
| C E 105      | Introduction to the Civil Engineering Profession | 1 |
| C E 170      | Graphics for Civil Engineering                   | 2 |
| C E 111      | Fundamentals of Surveying I                      | 3 |
| SSH Elective |  | 3 |

##### Computer Engineering

|                 |   |   |
|-----------------|---|---|
| COM S 227       | Introduction to Object-oriented Programming | 4 |
| CPR E 166       | Professional Programs Orientation           | R |
| Gen Ed Elective |   | 3 |

##### Construction Engineering

|           |  |   |
|-----------|--|---|
| CON E 121 | Cornerstone Learning Community: Orientation to Academic Life     | 1 |
| CON E 122 | Cornerstone Learning Community: Orientation to Professional Life | 1 |

One of the following 3

|              |                                |   |
|--------------|--------------------------------|---|
| PSYCH 101    | Introduction to Psychology     |   |
| PSYCH 230    | Developmental Psychology       |   |
| PSYCH 250    | Psychology of the Workplace    |   |
| PSYCH 280    | Social Psychology              |   |
| SOC 134      | Introduction to Sociology      |   |
| C E 170      | Graphics for Civil Engineering | 2 |
| SSH Elective |                                | 3 |

**Electrical Engineering**

|                 |  |   |
|-----------------|--|---|
| E E 285         | Problem Solving Methods and Tools for Electrical Engineering | 4 |
| E E 166         | Professional Programs Orientation                            | R |
| Gen Ed Elective |  | 3 |

**Industrial Engineering**

|              |                                   |   |
|--------------|-----------------------------------|---|
| I E 101      | Industrial Engineering Profession | R |
| SSH Elective |                                   | 6 |

**Materials Engineering**

|                 |   |   |
|-----------------|---|---|
| CHEM 177        | General Chemistry I *   | 4 |
| CHEM 177L       | Laboratory in General Chemistry I                                 | 1 |
| CHEM 178        | General Chemistry II  | 3 |
| CHEM 178L       | Laboratory in College Chemistry II                                | 1 |
| ENGR 160        | Engineering Problems with Computer Applications Laboratory        | 3 |
| Gen Ed Elective |   | 3 |
| PHYS 221        | Introduction to Classical Physics I (scheduled in sophomore year) | 5 |

**Mechanical Engineering**

|                 |  |   |
|-----------------|--|---|
| M E 170         | Engineering Graphics and Introductory Design | 3 |
| Gen Ed Elective |  | 3 |

**Software Engineering**

|           |   |   |
|-----------|---|---|
| S E 166   | Careers in Software Engineering             | R |
| COM S 227 | Introduction to Object-oriented Programming | 4 |
| COM S 228 | Introduction to Data Structures             | 3 |

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 C E<sup>1</sup>, Ch E, or Mat E will find CHEM 177 General Chemistry I to be a better preparation for CHEM 178 General Chemistry II. However CHEM 167 General Chemistry for Engineering Students, is accepted as a substitute for CHEM 177 General Chemistry I for those students declaring one of these curricula after having completed CHEM 167 General Chemistry for Engineering Students.

\*\*Recommended choices by program:

Credit hours for graduation will be given for any one of the following without increasing a curriculum's minimum number of credits required for graduation:

|           |  |   |
|-----------|--|---|
| AER E 160 | Aerospace Engineering Problems With Computer Applications Laboratory | 3 |
| A B E 160 | Systematic Problem Solving and Computer Programming                  | 3 |
| C E 160   | Engineering Problems with Computational Laboratory                   | 3 |
| CH E 160  | Chemical Engineering Problems with Computer Applications Laboratory  | 3 |
| ENGR 160  | Engineering Problems with Computer Applications Laboratory           | 3 |
| I E 148   | Information Engineering  | 3 |
| CPR E 185 | Introduction to Computer Engineering and Problem Solving I           | 3 |
| E E 185   | Introduction to Electrical Engineering and Problem-Solving I         | 3 |
| M E 160   | Mechanical Engineering Problem Solving with Computer Applications    | 3 |
| S E 185   | Problem Solving in Software Engineering                              | 3 |

\*\*\*Students enrolled in the joint software engineering degree program will take S E 101 Software Engineering Orientation. Honors students in Aer E enroll in AER E 101H Engineering Honors Orientation.

Students in the general emphasis in C E have two chemistry/physics sequence options. The environmental emphasis requires Option 1.

**Option 1**

|           |                                   |   |
|-----------|-----------------------------------|---|
| CHEM 177  | General Chemistry I               | 4 |
| CHEM 177L | Laboratory in General Chemistry I | 1 |

|           |                                     |   |
|-----------|-------------------------------------|---|
| CHEM 178  | General Chemistry II                | 3 |
| CHEM 178L | Laboratory in College Chemistry II  | 1 |
| PHYS 221  | Introduction to Classical Physics I | 5 |

**Option 2**

|                     |   |    |
|---------------------|---|----|
| CHEM 177            | General Chemistry I   | 4  |
| CHEM 177L           | Laboratory in General Chemistry I   | 1  |
| PHYS 221 & PHYS 222 | Introduction to Classical Physics I and Introduction to Classical Physics II **** | 10 |

\*\*\*\*Students who opt for PHYS 222 Introduction to Classical Physics II rather than CHEM 178 General Chemistry II, CHEM 178L Laboratory in College Chemistry II will increase the total number of credits required by 1.