

TECHNOLOGY SYSTEMS MANAGEMENT

Undergraduate Study

The Department of Agricultural and Biosystems Engineering offers work for the bachelor of science degree with majors in agricultural systems technology and industrial technology.

Missions

The mission of the Agricultural Systems Technology program is to prepare women and men for careers that integrate and apply agricultural and biosystems engineering technology to manage human and natural resource systems for producing, processing, and marketing food and other biological products worldwide.

The mission of the Industrial Technology is to prepare women and men for careers that integrate and apply industrial technology to lead and manage human, manufacturing, and safety systems.

Objectives

At two to five years after undergraduate graduation, through the professional practice in technology, graduates should:

1. Have demonstrated competence in methods of analysis involving use of mathematics, fundamental physical and biological sciences, technology, and computation needed for the professional practice in the field of agricultural systems technology or industrial technology.
2. Have developed skills necessary to contribute to the design process; including the abilities to think creatively, to formulate problem statements, to communicate effectively, to synthesize information, and to evaluate and implement problem solutions.
3. Be capable of addressing issues of ethics, safety, professionalism, cultural diversity, globalization, environmental impact, and social and economic impact in professional practice.
4. Have demonstrated continuous professional and technical growth, with practical experience, so as to be licensed in their field or achieve that level of expertise, as applicable.
5. Have demonstrated the ability to:
 - a. be a successful leader of multi-disciplinary teams.
 - b. efficiently manage multiple simultaneous projects.
 - c. work collaboratively.
 - d. implement multi-disciplinary systems-based solutions.

e. to apply innovative solutions to problems through the use of new methods or technologies.

f. contribute to the business success of their employer, and

g. build community.

Outcomes

At the time of graduation, students of the Agricultural Systems Technology or Industrial Technology programs should have:

a) an ability to apply knowledge of mathematics, science, technology, and applied sciences;

b) an ability to design and conduct experiments, as well as to analyze and interpret data;

c) an ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;

d) an ability to function on multi-disciplinary teams;

f) an understanding of professional and ethical responsibility;

g) an ability to communicate effectively;

h) the broad education necessary to understand the impact of solutions in a global, economic, environmental, and societal context;

i) a recognition of the need for, and an ability to engage in life-long learning;

j) a knowledge of contemporary issues; and

k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice.

Graduates have developed and demonstrated workplace competencies, and have completed a professional internship. They are able to communicate effectively, have problem-solving skills and awareness of global, economic, environmental and societal issues.

Agricultural Systems Technology graduates have the ability to apply science and technology to problems related to agriculture; they manage complex agricultural systems for sustainability. They find careers within a variety of agriculturally-related industries, businesses, and organizations, including: agricultural machinery, environment, government, farm builders, grain, feed, seed, fertilizer, chemical, food, biorenewable resources, and production agriculture.

Industrial Technology graduates understand commonly-used manufacturing processes, lean manufacturing principles, continuous improvement, quality management, safety, regulatory issues affecting

manufacturing, and the properties of manufacturing materials. They find careers within a variety of industries, businesses, and organizations focusing in manufacturing (e.g., quality control, production supervision, and process and facility planning) or occupational safety (e.g., development, management, and evaluation of safety programs and systems; and hazard identification and mitigation).

Agricultural Systems Technology, B.S. - Agricultural and biosystems management option

First Year

Fall	Credits Spring	Credits
TSM 110	1 TSM 111	1
TSM 116	3 TSM 115	3
CHEM 163	4 ECON 101	3
CHEM 163L	1 MATH 151	3
ENGL 150	3 PHYS 111	5
LIB 160	1	
MATH 145	3	
16		15

Second Year

Fall	Credits Spring	Credits
TSM 201	1 TSM 322	3
TSM 210	3 TSM 322L	1
TSM 214	1 BIOL 101 or BIOL 211	3
TSM 270	3 ECON 230	3
ACCT 284	3 STAT 104	3
ENGL 250	3 SP CM 212, COMST 214, or AGEDS 311	3
14		16

Third Year

Fall	Credits Spring	Credits Summer	Credits
TSM 325	3 TSM 310	3 TSM 397	0
TSM 327	3 TSM 324	3	
TSM 363	4 TSM 330	3	
ENGL 302,	3 TSM 370	3	
ENGL 309,	(Ethics		
ENGL 314,	requirement)		
or AGEDS 327			

US	3 Life	3
Diversity - See list*	Science - See list	
16		15

Fourth Year

Fall	Credits Spring	Credits
TSM 399	2 TSM 416	3
TSM 433	3 International Perspective - See list*	3
TSM 415	2 Elective	6
Humanities - See list*	3	
Elective	7	
17		12

* See List - Speak with an academic adviser for options for each list

Agricultural Systems Technology, B.S. - machine systems option

First Year

Fall	Credits Spring	Credits
TSM 110	1 TSM 111	1
TSM 116	3 TSM 115	3
CHEM 163	4 MATH 151	3
CHEM 163L	1 PHYS 111	5
ENGL 150	3 US Diversity - See list*	3
LIB 160	1	
MATH 145	3	
16		15

Second Year

Fall	Credits Spring	Credits
TSM 201	1 TSM 214	1
TSM 210	3 TSM 216	2
TSM 270	3 A B E 271, A B E 272, or A B E 273	1
ACCT 284	3 TSM 240	3
ECON 101	3 BIOL 101 or BIOL 211	3
ENGL 250	3 STAT 104	3

SP CM 212, COMST 214, or AGEDS 311	3
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16	16

Third Year

Fall	Credits Spring	Credits Summer	Credits
TSM 335	4 TSM 310	3 TSM 397	0
TSM 363	4 TSM 330	3	
TSM 433	3 TSM 337	3	
ENGL 302, ENGL 309, ENGL 314, or AGEDS 327	3 Humanites - See list	3	
	Life Science - See list	3	
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14	15	0	

Fourth Year

Fall	Credits Spring	Credits
TSM 399	2 TSM 370 (Ethics requirement)	3
TSM 415	2 TSM 416	3
Elective	9 TSM 443	3
International Perspective - See list*	3 TSM 465	3
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16	12	

* See list - Speak with an academic adviser for options for each list.

Industrial Technology, B.S. - manufacturing option

First Year

Fall	Credits Spring	Credits
TSM 110	1 TSM 111	1
TSM 116	3 TSM 115	3
ENGL 150	3 MATH 151	3
LIB 160	1 PHYS 111	5
MATH 145	3 ECON 101	3
CHEM 163	4	
CHEM 163L	1	
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16	15	

Second Year

Fall	Credits Spring	Credits
TSM 201	1 TSM 216	2
TSM 210	3 A B E 271, A B E 272, or A B E 273	1
TSM 214	1 STAT 104	3
TSM 240	3 BIOL 101 or BIOL 211	3
TSM 270	3 International Perspective - See list*	3
ENGL 250	3 SP CM 212, COMST 214, or AGEDS 311	3
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14	15	

Third Year

Fall	Credits Spring	Credits Summer	Credits
TSM 340	3 TSM 310	3 TSM 397	0
TSM 363	4 TSM 337	3	
ACCT 284	3 TSM 370 (Ethics requirement)	3	
US Diversity - See list*	3 Humanities - See list*	3	
ENGL 302, ENGL 309, ENGL 314, or AGEDS 327	3 Life Science - See list	3	
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16	15	0	

Fourth Year

Fall	Credits Spring	Credits
TSM 399	2 TSM 416	3
TSM 415	2 TSM 443	3
TSM 440	3 TSM 465	3
TSM 444	3 Elective	4
Elective	6	
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16	13	

* See list - Speak with an academic adviser for options for each list.

Industrial Technology, B.S. - occupational safety option

First Year

Fall	Credits Spring	Credits
TSM 110	1 TSM 111	1
TSM 116	3 TSM 115	3
ENGL 150	3 MATH 151	3
LIB 160	1 PHYS 111	5
MATH 145	3 ECON 101	3
CHEM 163	4	
CHEM 163L	1	
	16	15

Second Year

Fall	Credits Spring	Credits
TSM 201	1 TSM 214	1
TSM 210	3 TSM 240	3
TSM 270	3 TSM 371	2
H S 105	2 STAT 104	3
ENGL 250	3 BIOL 155	3
BIOL 101 or BIOL 211	3 SP CM 212, COMST 214, or AGEDS 311	3
	15	15

Third Year

Fall	Credits Spring	Credits Summer	Credits
TSM 363	4 TSM 310	3 TSM 397	0
TSM 376 [#]	3 TSM 370	3	
PSYCH 250	3 ACCT 284	3	
TSM 477 [#]	3 International Perspective [*]	3	
ENGL 302, ENGL 309, ENGL 314, or AGEDS 327	3 Electives	3	
	16	15	0

Fourth Year

Fall	Credits Spring	Credits
TSM 372 ^{**}	2 TSM 416	3
TSM 399	2 US Diversity [*]	3
TSM 415	2 Humanities [*]	3
TSM 470 ^{##}	3 Elective	3

TSM 471 ^{##}	1
Elective	6
	16
	12

* See list - Speak with an academic adviser for options for each list.

** TSM 372 - odd years, Fall only (Fall 2013, Fall 2015, etc.)

TSM 376 - even years, Fall only (Fall 2014, Fall 2016, etc.)
TSM 477 - even years, Fall only (Fall 2014, Fall 2016, etc.)

TSM 470 - even years, Spring only (Spring 2014, Spring 2016, etc.)
TSM 471 - even years, Spring only (Spring 2014, Spring 2016, etc.)

Graduate Study

The department offers work for the degrees master of science, and doctor of philosophy with a major in industrial and agricultural technology. It cooperates in the interdepartmental programs in professional agriculture, sustainable agriculture, environmental sciences, biorenewable resources and technology, and human computer interaction.

The master's program prepares advanced practicing professionals for industrial and/or agricultural technology positions in industry, business, and public service; it also provides a sound foundation for further graduate study. The doctoral program prepares exemplary industrial and/or agricultural technology professionals for learning, discovery, engagement, and leadership roles in education, industry, business, and public service organizations.

The department also offers work for the degrees master of science, master of engineering, and doctor of philosophy with a major in agricultural engineering. See College of Engineering, Curricula.

Visit our departmental website at www.abe.iastate.edu (<http://www.abe.iastate.edu>)

Certificate in occupational safety

The Department of Agricultural and Biosystems Engineering offers a undergraduate certificate in occupational safety (<http://www.abe.iastate.edu/undergraduate-students/industrial-technology/certificate-in-occupational-safety>) which may be earned by completing a minimum of 20 credits of technology systems management courses, which includes:

TSM 270	Principles of Injury Prevention and Safety	3
TSM 370	Occupational Safety	3
TSM 371	Occupational Safety Management	2
TSM 372	Legal Aspects of Occupational Safety and Health	2
TSM 470	Industrial Hygiene: Physical, Chemical, and Biological Hazards	3
6 credits from a departmentally approved list		6

TSM 493D Workshop in Technology: Occupational Safety
(Note: This course needs to be the last course taken toward completion of the Occupational Safety Certificate)

Courses primarily for undergraduates:

TSM 110: Introduction to Technology

(1-0) Cr. 1. F.

Prereq: AST or I Tec majors only or permission of instructor

Team-oriented introduction to agricultural systems technology and industrial technology. Internships, careers, competencies, academic success strategies, transition to academic life.

TSM 111: Experiencing Technology

(0-2) Cr. 1. S.

Prereq: AST or I Tec majors only or permission of instructor

Laboratory-based, team-oriented experiences in a spectrum of topics common to the practice of technology. Internships, competencies, industry visits.

TSM 114: Developing Responsible Learners and Effective Leaders

(Cross-listed with CON E, FS HN, HORT, NREM). (2-0) Cr. 2. S.

Prereq: NREM 112

Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

TSM 115: Solving Technology Problems

(2-2) Cr. 3. F.S.

Prereq: Credit or enrollment for credit in MATH 140 or higher

Solving technology problems and presenting solutions through data analysis and technical report writing. Problem solving cycle, unit conversion, unit factor method, SI units, significant digits, graphing, curve fitting and computer programming. Use of modern hardware and software tools for applied data-driven problem solving.

TSM 116: Introduction to Design in Technology

(2-2) Cr. 3. F.S.

Use of parametric solid modeling software to create three dimensional solid models and document parts and assemblies. Includes national and international standards for documentation, design projects, and teamwork. Rapid prototyping design creation, 3D printing, assemblies, rendering, and detailing technical drawings.

1-4 **TSM 201: Preparing for Workplace Seminar**

(Cross-listed with A B E). (1-0) Cr. 1. F.S.

Prereq: Prereq: Sophomore classification in AE, AST, BSE, or I TEC

8 week course. Professionalism in the context of the engineering/technical workplace. Development and demonstration of key workplace competencies: teamwork, initiative, communication, and engineering/technical knowledge. Resumes; Cover Letters; Behavioral Based Interviewing; Industry Speakers; Preparation for internships experiences.

TSM 210: Fundamentals of Technology

(3-0) Cr. 3. F.S.

Prereq: TSM 115 or equivalent; and MATH 140 or higher

Introduction to problem solving related to fundamental agricultural and/or industrial technology systems and mathematical tools needed for data analysis. Basic laws of energy, force, and mass applied to technology systems such as: mechanical power transmission; heating, ventilation and air conditioning; electrical circuits. Introduction to engineering economics: using the time value of money to make economic decisions.

TSM 214: Managing Technology Projects

(2-0) Cr. 1. F.S.

Prereq: TSM 201 or A B E 201; and sophomore classification in A E, AST, BSE, or ITEC.

8 week course. Introduction to project management principles. Use of project management in technology-based projects for academic, industry, and personal use.

TSM 216: Advanced Technical Graphics, Interpretation, and CAD

(1-2) Cr. 2. F.S.

Prereq: TSM 116

Advanced computer-aided-design topics incorporating 3D design and documentation used in manufacturing settings. Topics include: geometric dimensioning and tolerancing, weldments, sheet metal parts, advanced visualization, feature based design of parts and assemblies.

TSM 240: Introduction to Manufacturing Processes for Metals

(1-4) Cr. 3. F.S.

Prereq: MATH 145

A study of selected materials and related processes used in metals manufacturing. Lecture and laboratory activities focus on materials, properties, and processes.

TSM 241: Introduction to Manufacturing Processes for Plastics

(1-2) Cr. 2. F.S.

Prereq: MATH 145

A study of selected materials and related processes used in plastics manufacturing. Lecture and laboratory activities focus on materials, properties, and processes.

TSM 270: Principles of Injury Prevention and Safety

(3-0) Cr. 3. F.S.

Basic foundations of injury causation and prevention from a personal perspective in home, motor vehicle, and the public environment, and a management perspective within the work environment. Offered online only.

TSM 310: Total Quality Improvement

(3-0) Cr. 3. S.

Prereq: STAT 101 or STAT 104, junior classification

Introduction to the fundamental concepts of TQM - Deming style of management, statistical studies to understand the behavior of products, processes, or services, and how to define and document processes and customer focus. Introduction to continuous improvement tools and methods - emphasis on team work and problem solving skills.

TSM 322: Preservation of Grain Quality

(3-0) Cr. 3. S.

Prereq: MATH 140 or higher

Principles and management for grain quality preservation. Quality measurement. Drying and storage. Fans and airflow through grain. Handling methods.

TSM 322L: Preservation of Grain Quality Laboratory

(0-3) Cr. 1. S.

Prereq: Credit or enrollment for credit in TSM 322

Hands-on experiences in the principles and management for grain quality preservation. Quality measurement. Drying and storage. Fans and airflow through grain. Handling methods. System planning. Industry tour.

TSM 324: Soil and Water Conservation Management

(2-2) Cr. 3. S.

Prereq: MATH 140 or MATH 151

Introduction to engineering and conservation principles applied to the planning of erosion control systems, water control structures, water quality management, and drainage and irrigation systems.

TSM 325: Biorenewable Systems

(Cross-listed with A B E). (3-0) Cr. 3. F.

Prereq: CHEM 163 or higher; MATH 140 or higher

Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, and transportation/logistics.

TSM 327: Animal Production Systems

(3-0) Cr. 3. F.

Prereq: TSM 210

Confined animal feeding operations. Environmental controls for animal production. Response of animals to the environment. Heat and moisture balance in animal housing. Ventilation, water, feed handling, air pollution, odor and waste management systems.

TSM 330: Agricultural Machinery and Power Management

(2-3) Cr. 3. S.

Prereq: MATH 145 or MATH 151; and TSM 210

Selection, sizing, and operational principles of tractors and machinery systems. Cost analysis and computer techniques applied to planning and management of agricultural machine systems. Principles, operation, and application of agricultural machinery.

TSM 335: Tractor Power

(3-3) Cr. 4. F.

Prereq: TSM 210, MATH 145

Theory and construction of tractor engines, mechanical power trains and hydraulic systems. Introduction to traction, chassis mechanics, and hydraulic power.

TSM 337: Fluid Power Systems Technology

(2-2) Cr. 3. S.

Prereq: TSM 210

Fundamental fluid power principles. Fluid properties. Function and performance of components such as pumps, valves, actuators, hydrostatic transmission. Analysis of fluid power circuits and systems. Introduction to electrohydraulics. Simulation of hydraulic systems with software. Course includes lab using fluid power trainers.

TSM 340: Advanced Automated Manufacturing Processes

(2-2) Cr. 3. F.

Prereq: TSM 210, TSM 216, TSM 240, MATH 151

NC programming operations for CNC mills and lathes. Transfer of parts descriptions into detailed process plans, tool selection, and NC codes. Computer assisted CAD/CAM NC programming for 2D/3D machining and machining of student programmed NC code in lab.

TSM 363: Electrical Power Systems and Electronics for Agriculture and Industry

(3-3) Cr. 4. F.S.

Prereq: TSM 210, MATH 145

Fundamental electrical power theory and applications, code requirements, and safety considerations. Single-phase and three-phase circuits design, analysis, and safety; electric motor performance characteristics; motor controls; electrical conductor and safety equipment selection; lighting system technology and design; and electric power usage. Emphasis on agricultural and industrial applications.

TSM 370: Occupational Safety

(3-0) Cr. 3. F.S.

Prereq: TSM 270, junior standing

Identifies safety and health risks in industrial work environments. Focus on how managers and supervisors meet their responsibilities for providing a safe workplace for their employees. Includes the identification and remediation of workplace hazards.

TSM 371: Occupational Safety Management

(2-0) Cr. 2. S.

Introduction to occupational safety and health administration and management. Focus on development and management of safety programs and obtaining employee involvement in occupational safety programs.

TSM 372: Legal Aspects of Occupational Safety and Health

(2-0) Cr. 2. F.

Prereq: TSM 371

A review of the common legal issues facing safety practitioners in the workplace. Includes OSHA, EPA and DOT regulations; workers' compensation, as well as common liability issues.

TSM 376: Fire Protection and Prevention

(3-0) Cr. 3. F.

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.

TSM 393: Topics in Technology

Cr. 1-4. F.S.SS.

Offered as demand warrants. Web-based instruction.

TSM 393A: Topics in Technology: Agriculture and Biosystems Management

Cr. 1-4. F.S.SS.

Offered as demand warrants. Web-based instruction.

TSM 393B: Topics in Technology: Machine Systems

Cr. 1-4. F.S.SS.

Offered as demand warrants. Web-based instruction.

TSM 393C: Topics in Technology: Manufacturing

Cr. 1-4. F.S.SS.

Offered as demand warrants. Web-based instruction.

TSM 393D: Topics in Technology: Occupational Safety

Cr. 1-4. F.S.SS.

Offered as demand warrants. Web-based instruction.

TSM 393E: Topics in Technology: Chemical Application Systems

Cr. 1-4. F.S.SS.

Offered as demand warrants. Web-based instruction.

TSM 393F: Topics in Technology: Agricultural Safety and Health

Cr. 1-4. F.S.SS.

Offered as demand warrants. Web-based instruction.

TSM 393G: Topics in Technology: Electronic Integration for Agriculture and Production Systems

Cr. 1-4. F.S.SS.

Offered as demand warrants. Web-based instruction.

TSM 393I: Topics in Technology: Irrigation Systems Management

Cr. 1-4. F.S.SS.

Offered as demand warrants. Web-based instruction.

TSM 393J: Topics in Technology: Machinery Management Using Precision Agriculture Technology

Cr. 1-4. F.S.SS.

Offered as demand warrants. Web-based instruction.

TSM 397: Internship in Technology

Cr. R. Repeatable. F.S.SS.

Prereq: At least 45 credits of coursework, AST or I Tec major, and approval of internship coordinator

A supervised work experience in an approved learning setting with application to technology practices and principles. Reporting during work experience and self and employer evaluation required. Minimum GPA requirement.

TSM 399: Work Experience in Technology

Cr. 2. Repeatable, maximum of 4 credits. F.S.SS.

Prereq: TSM 397 in the preceding semester and approval of internship coordinator

Written reports and reflection on work experience. A maximum of 4 credits of TSM 399 maybe be used toward the total credits required for graduation.

TSM 415: Applied Project Management in Technology

(1-2) Cr. 2. F.S.

Prereq: Senior classification with less than 32 credits remaining; TSM 214; and credit or enrollment for credit in TSM 310.

Implementation of project management principles using case studies and teamwork; problem definition in a technology context; development of charter for technology capstone project.

TSM 416: Technology Capstone

(1-4) Cr. 3. F.S.

Prereq: TSM 415 in previous semester

Application of project management tools to a technology capstone project; development and evaluation of potential project solutions using tools from the technology curriculum; problem resolution emphasizing communication, critical analysis, and planning techniques; presentation of project through oral presentation and written reports with input from client, faculty, and other stakeholders.

TSM 433: Precision Agriculture

(Dual-listed with TSM 533). (2-2) Cr. 3. F.

Prereq: Junior standing.

Geographic information systems (GIS) and global positioning systems (GPS). Hardware systems for precision farming emphasized. Autosteering and automatic implement control systems. Collection and management of yield data. Sampling strategies for precision farming. Introduction to building fertilizer prescriptions and recommendations. Economic benefits of precision farming systems.

TSM 440: Cellular Lean Manufacturing Systems

(2-2) Cr. 3. F.

Prereq: TSM 310

Introduction to lean tools and techniques that reduce costs and improve business performance: JIT, VSM, SMED, Kaizen, Standard Work, Cycle Time Reduction, Takt Time, A3, etc. Emphasis on lean thinking and competency development through application: simulations, case studies, industry guests and mentors, teamwork and industry-related lean projects.

TSM 443: Statics and Strength of Materials for Technology

(2-2) Cr. 3. S.

Prereq: PHYS 111; and MATH 145 or MATH 151

Application of standard analytic and computer based techniques of solving problems related to force and moments. The properties of materials and how to select appropriate materials for a particular design is reviewed.

TSM 444: Facility Planning

(3-0) Cr. 3. F.

Prereq: TSM 216; TSM 240; and STAT 101 or STAT 104

Fundamental principles and practices in designing, evaluating, and organizing new or existing facilities. Emphasis on AutoCAD-based facility design and production flow analysis, activity relationship analysis, lighting analysis, time studies, materials handling, supporting services design, and optimal facility location analysis.

TSM 455: Feed Processing and Technology

(Dual-listed with TSM 555). Cr. 3. F.

Prereq: Junior classification

Introduction to formula feed manufacturing and the animal feed industry. Overview of feed ingredients and formulation, understanding and operation of feed production processing equipment including principles of conveying, grinding, mixing, conditioning, pelleting, and other processing techniques, and the formulation of concentrates, premixes, and rations. Students will become knowledgeable about the manufacturing of various animal feed types such as pelleted and extruded feed, aqua (fish) feed, liquid feeds, poured and pressed blocks, steam flaked feed, and pet food, and their effect on animal performance and health.

TSM 457: Feed Safety, Ingredient Quality and Analytics

(Dual-listed with TSM 557). Cr. 3. S.

Prereq: Junior classification

Concepts of feed and grain safety and quality, including hazards and risks associated with common feeds and feed ingredients. Methods to monitor, manage, and mitigate hazards and risks in the context of feed and grain industries. Government regulations applicable to feed and grain safety. Differences between safety and quality factors, how they are measured and then used for decision-making (marketing, processing, or safe-use).

TSM 465: Automation Systems

(2-2) Cr. 3. S.

Prereq: TSM 363

Theory and applications of automation systems. Emphasizes features, capabilities, design and programming skills of Programmable Logic Controller (PLC) based industrial control systems. Introduction to industrial robots and sensors.

TSM 470: Industrial Hygiene: Physical, Chemical, and Biological Hazards

(3-0) Cr. 3. S.

Prereq: MATH 151 or higher

A qualitative and quantitative introduction to health effects of chemical, biological, and physical hazards in a workplace.

TSM 471: Safety Laboratory

(0-2) Cr. 1. S.

Prereq: Credit or enrollment for credit in TSM 470

Introduction to equipment, methods, and strategies to measure, evaluate, control, and research hazards and risk in the workplaces.

TSM 477: Risk Analysis and Management

(Dual-listed with TSM 577). (3-0) Cr. 3. F.

Prereq: MATH 151; and STAT 101 or STAT 104

Risk analysis and management focuses on developing a risk oriented pattern of thinking that is appropriate for today's complex world. The tools that will be gained in this course will be helpful in recognizing, understanding, and analyzing hazards and risks in modern complex systems.

TSM 490: Independent Study

Cr. 1-4. Repeatable.

Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department

A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.

TSM 490H: Independent Study: Honors

Cr. 1-4. Repeatable.

Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department

A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.

TSM 490I: Independent Study: Manufacturing

Cr. 1-4. Repeatable.

Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department

A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.

TSM 490J: Independent Study: Agriculture and Biosystems Management

Cr. 1-4. Repeatable.

Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department

A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.

TSM 490M: Independent Study: Machine Systems

Cr. 1-4. Repeatable.

Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department

A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.

TSM 490O: Independent Study: Occupational Safety

Cr. 1-4. Repeatable.

Prereq: Junior or senior classification, permission of instructor, and completion of an independent study contract and approval by department

A maximum of 4 credits of TSM 490 may be used toward the total credits required for graduation.

TSM 493: Workshop in Technology

Cr. 1-4. Repeatable.

Offered as demand warrants.

TSM 493A: Workshop in Technology: Agriculture and Biosystems Management

Cr. 1-4. Repeatable.

Offered as demand warrants.

TSM 493B: Workshop in Technology: Machine Systems

Cr. 1-4. Repeatable.

Offered as demand warrants.

TSM 493C: Workshop in Technology: Manufacturing

Cr. 1-4. Repeatable.

Offered as demand warrants.

TSM 493D: Workshop in Technology: Occupational Safety

Cr. 1-4. Repeatable.

Offered as demand warrants.

TSM 495: Agricultural and Biosystems Engineering Department Study Abroad Preparation or Follow-up

(Cross-listed with A B E). Cr. 1-2. Repeatable. F.S.SS.

Prereq: Permission of instructor

Preparation for, or follow-up of, study abroad experience (496). For preparation, course focuses on understanding the tour destination through readings, discussions, and research on topics such as the regional industries, climate, crops, culture, economics, food, geography, government, history, natural resources, and public policies. For follow-up, course focuses on presentations by students, report writing, and reflection. Students enrolled in this course intend to register for 496 the following term or have had taken 496 the previous term.

Meets International Perspectives Requirement.

TSM 496: Agricultural and Biosystems Engineering Department Study Abroad

(Cross-listed with A B E). Cr. 1-4. Repeatable. F.S.SS.

Prereq: Permission of instructor

Tour and study at international sites relevant to disciplines of industrial technology, biological systems engineering, agricultural systems technology, and agricultural engineering. Location and duration of tours will vary. Trip expenses paid by students. Pre-trip preparation and/or post-trip reflection and reports arranged through 495.

Meets International Perspectives Requirement.

Courses primarily for graduate students, open to qualified undergraduates:

TSM 533: Precision Agriculture

(Dual-listed with TSM 433). (2-2) Cr. 3. F.

Prereq: Junior standing.

Geographic information systems (GIS) and global positioning systems (GPS). Hardware systems for precision farming emphasized. Autosteering and automatic implement control systems. Collection and management of yield data. Sampling strategies for precision farming. Introduction to building fertilizer prescriptions and recommendations. Economic benefits of precision farming systems.

TSM 540: Advanced Design and Manufacturing

(3-0) Cr. 3. S.

Prereq: Permission of instructor

Application of six sigma philosophy to advance product design and process control. Application of value stream mapping to the existing manufacturing system to develop future continuous improvement plans. Application of Taguchi Parameter design methodologies for optimizing the performance of manufacturing processes. Application of Taguchi Tolerance Design methodologies for product design.

TSM 555: Feed Processing and Technology

(Dual-listed with TSM 455). Cr. 3. F.

Prereq: Junior classification

Introduction to formula feed manufacturing and the animal feed industry. Overview of feed ingredients and formulation, understanding and operation of feed production processing equipment including principles of conveying, grinding, mixing, conditioning, pelleting, and other processing techniques, and the formulation of concentrates, premixes, and rations. Students will become knowledgeable about the manufacturing of various animal feed types such as pelleted and extruded feed, aqua (fish) feed, liquid feeds, poured and pressed blocks, steam flaked feed, and pet food, and their effect on animal performance and health.

TSM 557: Feed Safety, Ingredient Quality and Analytics

(Dual-listed with TSM 457). Cr. 3. S.

Prereq: Junior classification

Concepts of feed and grain safety and quality, including hazards and risks associated with common feeds and feed ingredients. Methods to monitor, manage, and mitigate hazards and risks in the context of feed and grain industries. Government regulations applicable to feed and grain safety. Differences between safety and quality factors, how they are measured and then used for decision-making (marketing, processing, or safe-use).

TSM 575: Safety and Public Health Issues in Modern Society

(2-0) Cr. 2. Repeatable, maximum of 2 times.

Exploration and analysis of current safety and public health issues impacting society. The focus will be on topics that impact individuals in work, public, and home environments.

TSM 577: Risk Analysis and Management

(Dual-listed with TSM 477). (3-0) Cr. 3. F.

Prereq: MATH 151; and STAT 101 or STAT 104

Risk analysis and management focuses on developing a risk oriented pattern of thinking that is appropriate for today's complex world. The tools that will be gained in this course will be helpful in recognizing, understanding, and analyzing hazards and risks in modern complex systems.

TSM 590: Special Topics in Technology

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Graduate classification in industrial and agricultural technology, permission of instructor, and completion of an independent study contract approved by major professor

TSM 590A: Special Topics in Technology: Agriculture and Biosystems Management

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Graduate classification in industrial and agricultural technology, permission of instructor, and completion of an independent study contract approved by major professor

TSM 590B: Special Topics in Technology: Machine Systems

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Graduate classification in industrial and agricultural technology, permission of instructor, and completion of an independent study contract approved by major professor

TSM 590C: Special Topics in Technology: Manufacturing

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Graduate classification in industrial and agricultural technology, permission of instructor, and completion of an independent study contract approved by major professor

TSM 590D: Special Topics in Technology: Occupational Safety

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Graduate classification in industrial and agricultural technology, permission of instructor, and completion of an independent study contract approved by major professor

TSM 593: Workshop in Technology

Cr. 1-3. Repeatable.

Prereq: Permission of instructor

TSM 599: Creative Component

Cr. 1-3. Repeatable, maximum of 6 credits.

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:

TSM 601: Graduate Seminar

(Cross-listed with A B E). (1-0) Cr. 1. F.

Keys to starting a successful graduate research project. Effective literature review, formulating research questions, and setting goals. Practicing effectively communicating research and science. Effective strategies for scholarly writing, responding to feedback, peer-reviewing, successful publishing in journals, and curating scholarly output.

TSM 652: Program and Learner Evaluation

(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 is emphasized.

TSM 655: Academic Leadership in Technology and Engineering

(3-0) Cr. 3.

Prereq: Permission of instructor

A definition of the faculty role in technology and engineering disciplines, including strategies for dealing with programs, personnel, and constituencies are presented. Leadership skills involving team formation, team operation, and conflict resolution are addressed.

TSM 657: Curriculum Development in Technology and Engineering

(3-0) Cr. 3.

Prereq: Permission of instructor

Basic concepts, trends, practices, and factors influencing curriculum development, techniques, organization and procedures. Emphasis will be given to course development using the backward design process.

TSM 694: Teaching Practicum

(Cross-listed with A B E). Cr. 1-3. Repeatable. F.S.

Prereq: Graduate classification and permission of instructor

Graduate student experience in the agricultural and biosystems engineering departmental teaching program.

TSM 697: Internship in Technology

Cr. R.

Prereq: permission of major professor and approval by department chair, graduate classification

One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

TSM 699: Research

Cr. arr.