INDUSTRIAL TECHNOLOGY

Administered by the Department of Agricultural and Biosystems Engineering.

An undergraduate certificate in occupational safety is available; the requirements appear under Technology Systems Management courses and programs. A minor in Industrial Technology is available; the requirements appear under Technology Systems Management (http://catalog.iastate.edu/collegeofagricultureandlifesciences/technologysystemsmanagement).

Students majoring in Industrial Technology choose between two options: Manufacturing or Occupational Safety.

Total Degree Requirement: 120 cr.

Only 65 cr. from a two-year institution may apply which may include up to 16 technical cr.; 9 P-NP cr. of free electives; 2.00 minimum GPA.

Communications Proficiency:
6 cr. of English composition with a C or better and 3 cr. of speech fundamentals with a C or better.

Communication/Library: 13 cr.

ENGL 150 Critical Thinking and Communication 3
ENGL 250 Written, Oral, Visual, and Electronic Composition 3
LIB 160 Information Literacy 1
One of the following: 3
ENGL 302 Business Communication
ENGL 309 Proposal and Report Writing
ENGL 314 Technical Communication
AGEDS 327 Advanced Communications for Agriculture and Life Sciences

One of the following: 3
SP CM 212 Fundamentals of Public Speaking
COMST 214 Professional Communication
AGEDS 311 Presentation and Sales Strategies for Agricultural Audiences

Total Credits 13

Mathematical, Physical, and Life Sciences: 26 cr.

STAT 104 Introduction to Statistics 3
MATH 145 Applied Trigonometry 3
MATH 151 Calculus for Business and Social Sciences 3
PHYS 111 General Physics 5
CHEM 163 College Chemistry 4
CHEM 163L Laboratory in College Chemistry 1
BIOL 101 Introductory Biology 3
or BIOL 211 Principles of Biology I
Second Biology course requirement by Option: 3
Manufacturing option
3 credits from approved College of Agriculture and Life Sciences list
Occupational Safety option

BIOL 255 Fundamentals of Human Anatomy

Total Credits 25

Business, Humanities, Ethics, and Social Sciences: 18 cr.

ACCT 284 Financial Accounting 3
ECON 101 Principles of Microeconomics 3
Ethics 3

TSM 370 Occupational Safety

Humanities course from College of Agriculture and Life Sciences list 3
International Perspectives course from University list 3
U.S. Diversity course from University list 3

Total Credits 18

Technical Core: 30 cr.

TSM 110 Introduction to Technology 1
TSM 111 Experiencing Technology 1
TSM 115 Solving Technology Problems 3
TSM 116 Introduction to Design in Technology 3
TSM 201 Preparing for Workplace Seminar 1
TSM 210 Fundamentals of Technology 3
TSM 270 Principles of Injury Prevention 3
TSM 310 Total Quality Improvement 3
TSM 363 Electric Power and Electronics for Agriculture and Industry 4

TSM 397 Internship in Technology R
TSM 399 Work Experience in Technology 2
TSM 415 Technology Capstone I 1
TSM 416 Technology Capstone II 5

Total Credits 30

No more than 4 cr. of TSM 397 may count toward graduation.

Manufacturing Option: 33 cr.

TSM 216 Advanced Technical Graphics, Interpretation, and CAD 2
A B E 271, A B E 272, or A B E 273 1
TSM 240 Introduction to Manufacturing Processes 3
TSM 337 Fluid Power Systems Technology 3
TSM 340 Advanced Automated Manufacturing Processes 3
TSM 440 Cellular Lean Manufacturing Systems 3
TSM 443 Statics and Strength of Materials for Technology 3
TSM 444 Facility Planning 3
TSM 465 Automation Systems 3
10 credits of free electives 10

Total Credits 34

Occupational Safety Option: 33 cr.

TSM 240 Introduction to Manufacturing Processes 3
TSM 371 Occupational Safety Management 2
TSM 372 Legal Aspects of Occupational Safety and Health 2
TSM 376 Fire Protection and Prevention 3
TSM 470 Industrial Hygiene: Physical, Chemical, and Biological Hazards 3

TSM 471 Safety Laboratory 1
TSM 477 Risk Analysis and Management 3
H S 105 First Aid and Emergency Care 2
PSYCH 250 Psychology of the Workplace 3

Total Credits 34
### Industrial Technology, B.S. - manufacturing option

**First Year**

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### Industrial Technology, B.S. - occupational safety option

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*See list - Speak with an academic adviser for options for each list.*
Courses primarily for undergraduates:

- Agricultural engineering
- Biological systems engineering
- Science

For the undergraduate curriculum in agricultural systems technology leading to the degree of bachelor of science or for the undergraduate curriculum in industrial technology leading to the degree of bachelor of science.

The department also offers an undergraduate curricula and courses in agricultural engineering, biological systems engineering.

**Minor - Industrial Technology**

The Department of Agricultural and Biosystems Engineering offers a minor in industrial technology which may be earned by completing a minimum of 18 credits of technology systems management courses, which includes:

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<th>Course Code</th>
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<tr>
<td>TSM 115</td>
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<td>Risk Analysis and Management</td>
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- At least six (6) credits of 300-level or higher TSM classes (from the courses listed above)
- At least nine (9) credits that are not used to meet any other department, college, or university requirement.

**Total Credits: 120**

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

**TSM 110: Introduction to Technology**

(1-0) Cr. 1. F.

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

Team-oriented introduction to agricultural systems technology and industrial technology. Internships, careers, competencies, academic success strategies, industry visits, 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. Report writing, internships, competencies, industry visits.

**TSM 115: Solving Technology Problems**

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

Prereq: MATH 140 or higher (can be taken concurrently)

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 model, and document, parts and assemblies. Includes national and international standards for documentation, design projects, and teamwork. Free-hand sketching techniques will be covered.

**TSM 201: Preparing for Workplace Seminar**

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

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, 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 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**

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

A study of selected materials and related processes used in manufacturing. Lecture and laboratory activities focus on materials, properties, and processes. This includes plastics and metals.
TSM 270: Principles of Injury Prevention  
(3-0) Cr. 3. F.  
Basic foundations of injury causation and prevention in home, motor vehicle, public, and work environments.

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  
(2-0) Cr. 2. 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  

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:** ECON 101, 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:** TSM 210, MATH 145 or MATH 151  
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 333: Precision Farming Systems  
(2-2) Cr. 3. F.  
**Prereq:** MATH 140 or higher, junior or senior classification  

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. Course includes lab using fluid power trainers.

TSM 340: Advanced Automated Manufacturing Processes  
(2-2) Cr. 3. F.  
**Prereq:** 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: Electric Power and Electronics for Agriculture and Industry  
(3-3) Cr. 4. F.  
**Prereq:** TSM 210  
Basic electricity. Electrical safety, wiring, 3-phase service, controls, and motors for agricultural and industrial applications. Planning building lighting and electrical systems. Electronics to sense, monitor, and control mechanical processes.

TSM 370: Occupational Safety  
(3-0) Cr. 3. 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. Alt. F., offered odd-numbered years.  
**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. Alt. F., offered even-numbered years.
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. F.S.SS.
Prereq: At least 45 credits of coursework, in 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 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: Technology Capstone I
(0-2) Cr. 1. F.S.
Prereq: senior classification with less than 32 credits remaining
Identification and definition of a current technological problem in agricultural or industrial systems. Formation of project teams, application of technology curriculum content, and use of team communication and management as applied to problem solving in technology.

TSM 416: Technology Capstone II
(1-8) Cr. 5. F.S.
Prereq: TSM 415 in previous semester
Continued team and project development, communications, and responsibilities. Development of alternate solutions using tools and knowledge from technology curriculum, creativity, critical analysis, and planning techniques. Selection of promising solutions to technology problem identified in TSM 415 for development and analysis. Presentation of project through oral presentations, written reports, and/or working prototypes.

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, 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 and TSM 240; STAT 101 or STAT 104
Fundamental principles and practices in designing, evaluating, and organizing new or existing facilities. Emphasis on CAD-based facility design, production flow analysis, activity relationship analysis, materials handling, office layout, supporting services design, and facility cost analysis.

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. Alt. F., offered odd-numbered years.
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. Alt. F., offered odd-numbered years.
Prereq: TSM 470 (can be taken concurrently)
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. Alt. F., offered even-numbered years.
Prereq: MATH 151, 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 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.

Courses primarily for graduate students, open to qualified undergraduates:

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 steam 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 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. Alt. F., offered even-numbered years.
Prereq: MATH 151, 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 598: Technical Communications for a Master's Degree
(Cross-listed with A B E). Cr. 1. F.S.S.S.
A technical paper draft based on the M.S. thesis or creative component is required of all master's students. This paper must be in a form that satisfies the requirements of some specific journal and be ready for submission. A technical presentation based on M.S. thesis or creative component is required of all master's students. This presentation must be in a form that satisfies the normal presentation requirements of a professional society. The presentation itself (oral or poster) may be made at a professional society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Offered on a satisfactory-fail basis only.

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 good MS thesis or PhD dissertation project. Learning how to formulate research problems. Discussion of broader impact, review of literature, identifying knowledge gaps and needs, long-term goals, research hypotheses, objectives, rationale and significance, and approaches for accomplishing research objectives. Preparation and communication of research proposal and project in different formats. Using peer review and responding to feedback.

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 program and course development.

TSM 694: Teaching Practicum
(Cross-listed with A B E). Cr. 1-3. Repeatable. F.S.S.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 698: Technical Communications for a Doctoral Degree
(Cross-listed with A B E). Cr. 1. F.S.S.
A technical paper draft based on the 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 ready for submission. A technical presentation based on the dissertation is required of all Ph.D. students. This presentation must be in a form that satisfies the normal presentation requirements of a professional society. The presentation itself (oral or poster) may be made at a professional society meeting or at any international, regional, state, or university conference/event as long as the presentation content and form conforms to normal expectations. Offered on a satisfactory-fail basis only.

TSM 699: Research
Cr. arr.