

# AGRICULTURAL SYSTEMS TECHNOLOGY

Administered by the Department of Agricultural and Biosystems Engineering. Students majoring in Agricultural Systems Technology choose between two options: Agricultural and Biosystems Management or Machine Systems.

## 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
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	
LIB 160	Information Literacy	1

**Total Credits** 13

## Mathematical, Physical, and Life Sciences: 26 cr.

MATH 151	Calculus for Business and Social Sciences	3
MATH 145	Applied Trigonometry	3
STAT 104	Introduction to Statistics	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	
Plus 3 life sciences credits from approved College of Agriculture and Life Sciences list		3

**Total Credits** 25

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

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

## Agricultural and Biosystems Management Option: 33 cr.

TSM 322	Preservation of Grain Quality	2
TSM 322L	Preservation of Grain Quality Laboratory	1
TSM 324	Soil and Water Conservation Management	3
TSM 325	Biorenewable Systems	3
TSM 327	Animal Production Systems	3
TSM 330	Agricultural Machinery and Power Management	3
TSM 333	Precision Farming Systems	3
ECON 230	Farm Business Management	3
13 credits of free electives		13

**Total Credits** 34

## Machine Systems 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 330	Agricultural Machinery and Power Management	3
TSM 333	Precision Farming Systems	3
TSM 335	Tractor Power	4
TSM 337	Fluid Power Systems Technology	3
TSM 443	Statics and Strength of Materials for Technology	3
TSM 465	Automation Systems	3
9 credits of free electives		9

**Total Credits** 34

## Minor in agricultural systems technology

The Department of Agricultural and Biosystems Engineering offers a minor in agricultural systems technology which may be earned by completing a minimum of 15 credits of technology systems management courses, which includes:

TSM 115	Solving Technology Problems	3
TSM 210	Fundamentals of Technology	3
9 credits from:		9
TSM 310	Total Quality Improvement	

TSM 322	Preservation of Grain Quality
TSM 322L	Preservation of Grain Quality Laboratory
TSM 324	Soil and Water Conservation Management
TSM 325	Biorenewable Systems
TSM 327	Animal Production Systems
TSM 330	Agricultural Machinery and Power Management
TSM 333	Precision Farming Systems
TSM 335	Tractor Power
TSM 337	Fluid Power Systems Technology
TSM 363	Electric Power and Electronics for Agriculture and Industry
TSM 393E	Topics in Technology: Chemical Application Systems
TSM 393F	Topics in Technology: Agricultural Safety and Health

• At least six (6) credits of 300-level or higher TSM classes (from the classes listed above)

• At least nine (9) credits that are not used to meet any other department, college, or university requirement.

**Total Credits**

**15**

#### Courses primarily for undergraduates:

##### 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: 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*

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: 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*

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 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 may 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**

(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 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 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.SS.

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.SS.

*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.SS.

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.