

99. Doctoral Dissertation Research
 Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course.
 L: Open only to Ph.D. students in Agricultural Economics. Approval of department.

AGRICULTURAL ENGINEERING

AE

Department of Agricultural Engineering
 College of Agriculture and Natural Resources
 College of Engineering

102. Agricultural Climatology
 Fall of even-numbered years. 3(3-0) Interdepartmental with Geography. Administered by Geography.
 P: MTH 116. R: Not open to freshmen and sophomores. Relationships between climate and agriculture in resource assessment, water budget analysis, meteorological hazards, pests, crop-yield modeling, and impacts of global climate change.

160. Resource and Environmental Economics
 Spring. 3(3-0) Interdepartmental with Resource Development, Public Resource Management, and Park and Recreation Resources. Administered by Resource Development.
 P: RD 201, EC 201. R: Not open to freshmen and sophomores.
 Economics of land and related environmental resources. Production and consumption processes. Resource allocations and scarcity. Market failure and externalities. Market and institutional remedial approaches.

802. Computational Methods in Food and Agricultural Engineering
 Fall of odd-numbered years. 3(3-0)
 P: MSM 809. R: Open only to graduate students in College of Engineering.
 Formulation and solution of mathematical equations in food and agricultural engineering. Constitutive equations. Linear and nonlinear problems. Steady state and transient problems. Computer solutions.

809. Finite Element Method
 Fall. 3(3-0) Interdepartmental with Materials Science and Mechanics, Civil Engineering, and Mechanical Engineering. Administered by Materials Science and Mechanics.
 R: Approval of department.
 Theory and application of the finite element method to the solution of continuum type problems in heat transfer, fluid mechanics, and stress analysis.

812. Bio-Processing Engineering
 Spring of odd-numbered years. 3(3-0)
 R: Open only to graduate students in College of Engineering.
 Thermodynamics, heat and mass transfer, fluid flow, dehydration. Handling and storage of biological products.

815. Instrumentation for Food and Agricultural Engineering
 Fall. 3(3-0)
 R: Open only to graduate students in College of Engineering.
 Theory and techniques of measuring temperature, pressure, flow, humidity, and moisture in biological materials.

820. Research Methods in Agricultural Engineering
 Fall. 1(1-0)
 R: Open only to graduate students in College of Agriculture and Natural Resources or College of Engineering. Procedures and methods for designing and executing research projects.

837. Rheological Methods in Food Processing Engineering
 Fall. 3(3-0) Interdepartmental with Food Science.
 Definition, analysis, and measurement of rheological properties to describe the steady shear, dynamic, viscoelastic, extensional, and solid behavior of biological materials. Industrial applications of rheological methods with emphasis on fluid and semi-solid foods.

850. Dimensional Analysis and Similitude Modelling
 Fall of odd-numbered years. 3(2-2)
 R: Open only to graduate students in College of Agriculture and Natural Resources or College of Engineering. Dimensional concepts, systems of measurements and transformation of units, and formation of dimensionless groups. Development of prediction equations, concepts of similarity, and scaling laws. Distortion.

882. Irrigation and Water Management Engineering
 Spring of even-numbered years. 3(3-0)
 P: AE 481, CE 321.
 Design and management of systems for supplemental irrigation. Water supply and transport. Economic and engineering optimization of irrigation design.

890. Special Problems
 Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course.
 R: Approval of department; application required.
 Individual study in agricultural engineering.

891. Advanced Topics in Agricultural Engineering
 Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course.
 R: Open only to graduate students in College of Engineering. Approval of department.
 Agricultural engineering topics not covered in regular courses.

892. Agricultural Engineering Seminar
 Spring. 1(1-0)
 R: Open only to graduate students in College of Agriculture and Natural Resources or College of Engineering. Current topics in agricultural engineering.

899. Master's Thesis Research
 Fall, Spring, Summer. 1 to 10 credits. A student may earn a maximum of 10 credits in all enrollments for this course.
 R: Open only to graduate students in Agricultural Engineering.

999. Doctoral Dissertation Research
 Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course.
 R: Open only to graduate students in Agricultural Engineering.

AGRICULTURAL TECHNOLOGY AND SYSTEMS MANAGEMENT ATM

Department of Agricultural Engineering
 College of Agriculture and Natural Resources
 College of Engineering

315. Occupational and Personal Safety
 Spring. 2(2-0)
 P: CSS 101 or ANS 110 or AEE 101 or HRT 201. R: Open only to College of Agriculture and Natural Resources majors.
 Principles of safety problem solving. Accident causation and prevention. Laws and regulations. Machinery, electrical, chemical and fire safety. Security. Safety program development.

326. Principles of Animal Environments
 Spring. 2(2-0)
 P: MTH 116 or MTH 120; CPS 100 or CPS 130 or CPS 131. R: Open only to College of Agriculture and Natural Resources majors.
 Heat and moisture balances for confined livestock. Interior environment and its control. Waste management.

431. Irrigation, Drainage and Erosion Control Systems
 Fall. 3(2-2)
 P: MTH 116 or MTH 120; CSS 210. R: Not open to freshmen and sophomores.
 Principles of soil and water conservation engineering including: land and soil surveying, basic hydraulics, hydrology, soil moisture, and soil and water conservation practices with applications to irrigation, drainage and erosion control systems.

490. Independent Study
 Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course.
 P: ATM 231 or ATM 240 or BCM 311. R: Open only to majors in Agricultural Technology and Systems Management. Approval of department; application required.
 Supervised individual student research and study in agricultural technology and systems management.

491. Special Topics in Agricultural Technology and Systems Management
 Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course.
 P: ATM 231 or ATM 240 or BCM 311. R: Open only to majors in Agricultural Technology and Systems Management.
 Special topics in agricultural technology and systems management.

804. Agricultural Mechanization in Developing Countries
 Fall of odd-numbered years. 3(3-0)
 R: Open only to graduate students in College of Agriculture and Natural Resources or College of Engineering.
 Human, animal and mechanical power for smaller farms. Machine selection, local manufacturing, ownership patterns.

807. Human Factors Engineering
 Fall of even-numbered years. 3(3-0)
 R: Open only to graduate students in College of Agriculture and Natural Resources or College of Engineering.
 Ergonomics. Analysis of machine designs, operation, and working environment in relation to human limitations and capabilities. Procedures to develop maximum human-machine compatibility and performance.

831. Water, Technology and International Development

Spring of even-numbered years. 3(3-0)

P: AE 481 or ANR 489 or ATM 431 or CSS 210. R: Open only to graduate students in College of Agriculture and Natural Resources or College of Engineering.

Water resources planning and development for irrigated agriculture. Technological, agronomic, environmental, social and political constraints. Case studies.

836. Microclimate and Its Measurement

Spring. 4(3-3) Interdepartmental with Geography.

The climate near the Earth's surface. Energy balance, thermal radiation exchange, heat fluxes, temperature sensors, wind speed and direction, humidity and evapotranspiration and their measurement.

840. Analysis of Physical Systems

Fall. 3(3-0)

P: ATM 440 or BCM 311 or MGT 306. R: Open only to graduate students in College of Agriculture and Natural Resources.

Identification and definition of systems problems in agricultural and construction industries. Model formulation and estimation.

845. Process Network Theory Applied to Agroecosystems

Spring of odd-numbered years. 4(4-0)

R: Open only to graduate students in College of Agriculture and Natural Resources or College of Engineering. Numerical framework for the technical, economic and environmental analysis of agricultural and biological systems.

890. Special Problems

Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course.

R: Approval of department.
Individual study of selected topics.

891. Advanced Topics in Agricultural Technology and Systems Management

Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course.

R: Open only to graduate students in College of Agriculture and Natural Resources or College of Engineering. New developments in agricultural technology and systems management.

899. Master's Thesis Research

Fall, Spring, Summer. 1 to 10 credits. A student may earn a maximum of 99 credits in all enrollments for this course.

R: Open only to graduate students in Agricultural Technology and Systems Management.

999. Doctoral Dissertation Research

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R: Open only to Ph.D. students in Agricultural Technology and Systems Management.

AGRICULTURE AND NATURAL RESOURCES ANR

College of Agriculture and Natural Resources

350. Leadership Development for Agriculture and Natural Resources

Spring. 2(2-0)

R: Not open to freshmen and sophomores. Approval of college; application required.

Preparation for community leadership. Field observation of social, economic and political problems. Emphasis on awareness, action and involvement. Seminars and interviews.

392. Agriculture and Natural Resources Seminar

Spring. 1(2-0)

R: Not open to freshmen and sophomores.
Current agricultural, natural resources and environmental problems and solutions. Discussion leaders from various disciplines.

475. International Studies in Agriculture and Natural Resources

Fall, Spring, Summer. Given at various off campus sites. 2 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course.

R: Approval of college; application required.
Study-travel experience emphasizing contemporary problems affecting agriculture and natural resources in the world, national and local communities. Case studies and interviews with officials, community leaders and leading professionals.

481. Agricultural Research Systems in Developing Countries

Summer. 2(2-0) Interdepartmental with Agricultural Economics, Animal Science, and Crop and Soil Sciences.

R: Open only to seniors and graduate students in the College of Agriculture and Natural Resources.
Planning, organizing and managing agricultural research systems. Problems and alternative reforms to improve research productivity. Adapting new agricultural technology in developing countries.

489. Integrated Approaches to Agriculture and Natural Resources Problems

Fall, Spring. 3(2-2)

P: MTH 110 or MTH 116; EC 201 or EC 202. R: Open only to seniors in the College of Agriculture and Natural Resources.

Holistic solutions to resource management and allocation: an integrated, multidisciplinary team approach to case study problems.

491. Selected Topics

Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course.

R: Not open to freshmen and sophomores.
Special topics in agriculture and natural resources.

493. Professional Internship in Agriculture and Natural Resources

Fall, Spring, Summer. 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course.

R: Open only to juniors and seniors in the College of Agriculture and Natural Resources. Approval of department; application required.
Supervised professional experiences in agencies and businesses related to a student's major field of study.

AMERICAN STUDIES AMS

College of Arts and Letters

332. Technology and Culture

Fall. 4(4-0) Interdepartmental with Lyman Briggs School. Administered by Lyman Briggs School. P: LBS 133. R: Not open to freshmen and sophomores. History of technology with special emphasis on the interaction of technical innovation and other elements of culture.

335. The Natural Environment: Perceptions and Practices

Spring. 4(4-0) Interdepartmental with Lyman Briggs School. Administered by Lyman Briggs School. P: LBS 133 or another Tier 1 writing course. R: Not open to freshmen. Open only to students in American Studies and in Lyman Briggs School. American attitudes toward the natural environment and related public and private institutions.

491. Perspectives in American Studies

Fall. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. R: Not open to freshmen and sophomores. Methods and significant works in American Studies. Topics vary.

492. Seminar in American Studies

Spring. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to majors in Arts and Letters, James Madison College, and Lyman Briggs School. Selected topics in American life emphasizing interdisciplinary approaches. Topics vary.

881. American Studies Theory, Methods, and Bibliography

Fall. 3(3-0)

Methods and bibliographical sources of American Studies research. Interdisciplinary approaches to studying American culture.

890. Independent Study

Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course.

R: Approval of college.
Special projects, directed reading, and research arranged by an individual graduate student and a faculty member in areas supplementing regular course offerings.

891. Special Topics in American Studies

Fall, Spring, Summer. 4(4-0) A student may earn a maximum of 12 credits in all enrollments for this course.

R: Approval of college.
Special topics supplementing regular course offerings proposed by faculty for graduate students on a group study basis.

899. Master's Thesis Research

Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course.

R: Approval of college.
Directed research leading to a master's thesis in partial fulfillment of Plan A master's degree requirements.