12. *American Agricultural Development and the Land-Grant System*
Fall. 3(3-0)
AEE 203. R: Not open to freshmen.
istorical overview of the evolution of American agriltural development and the land-grant system. Relaonship between federal legislation and agrarian stitutions such as farm organizations and land grant lleges.

91. *Agricultural and Natural Resources Communications Campaigns*
Fall, Spring, Summer. 3(3-0)
: Open only to juniors or seniors in the College of griculture and Natural Resources or College of Comunication Arts and Sciences.
lanning and execution of agricultural and natural esource communication campaigns. Emphasis on eories, strategies and techniques using mass and ntrolled media channels.

93. *Agricultural and Natural Resources Leadership and Education*
Fall, Spring, Summer. 3(3-0)
: Open only to juniors or seniors.
haracteristics of leadership, group dynamics, and delopment of personal leadership skills. Educational ethods and learning styles.

90. *Independent Study*
Fall, Spring, Summer. 1 to 4 credits. A student ay earn a maximum of 4 credits in all enrollments for is course.
: AEE 401. R: Open only to Agriscience or Agriculture nd Natural Resources Communications majors. Approval of department; application required.
ndividual study in areas of agriscience, extension edution, or agricultural and natural resources communications.

91. *Selected Topics*
Fall, Spring, Summer. 1 to 4 credits. A student ay earn a maximum of 4 credits in all enrollments for is course.
: AEE 101 or AEE 401. R: Open only to Agriscience or griculture and Natural Resources Communications ajors. Approval of department.
opics selected to meet student needs in agriculture nd natural resources communications or agriscience nd natural resources education.

01. *Global Development through Agricultural and Extension Education*
Fall. 3(3-0)
pplication of education theories: principles and praces in planning, conducting, and evaluating formal nd nonformal education programs on international evelopment.

02. *Program Administration in Agricultural and Extension Education*
Fall. 3(3-0)
rganizational and management concepts and praces in agricultural and extension education.

03. *Instructional Strategies in Agricultural and Extension Education*
Spring. 3(3-0)
ssessment of learning needs. Development, selection, se and evaluation of teaching strategies. Emphasis on griscience education and adult learners.

04. *Communication Strategies in Agricultural and Extension Education*
Fall. 3(3-0)
: Open only to seniors and graduate students in Colge of Agriculture and Natural Resources.
nformation delivery systems and presentation techiques for varied agricultural and extension audiences.

805. *Leadership Development in Agricultural and Extension Education*
Spring. 3(3-0)
Assessment of values, style, behavior, principles. Philosophical and sociological bases for leadership development. Applications.

806. *Program Planning and Evaluation in Agricultural and Extension Education*
Spring of odd-numbered years, Summer of even-numbered years. 3(3-0)
Principles, theories, and practices in developing and evaluating state and local agricultural and extension education programs.

807. *Research in Agricultural and Extension Education*
Fall. 3(3-0)
R: Open only to graduate students in College of Agriculture and Natural Resources.
Planning, designing, conducting, and reporting research in agricultural and extension education.

811. *Education Through Extension*
Fall. 3(3-0)
Function, organization, and operation of extension education programs.

821. *Principles and Philosophies of Agriscience Education*
Summer. 3(3-0)
Principles and philosophies for analyzing and developing agriscience education courses, curricula, and programs.

822. *Teaching Supervised Agriscience Experiences*
Summer of odd-numbered years. 3(3-0)
R: Open only to graduate students in Agricultural and Extension Education.
Principles and practices of agriscience laboratory teaching in high schools.

890. *Independent Study in Agricultural and Extension Education*
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.

891. *Selected Topics in Agricultural and Extension Education*
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 Agricultural and Extension Education.
Contemporary issues and problems in agricultural and extension education.

892. *Seminar in Agricultural and Extension Education*
Fall, Spring. 1(1-0) A student may earn a maximum of 2 credits in all enrollments for this course.
Selected issues in agricultural and extension education.

893. *Professional Field Experience in Agricultural and Extension Education*
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course.
R: Open only to graduate students in Agricultural and Extension Education.
Practice, observation, and analysis through field experiences.

898. *Master's Research*
Fall, Spring, Summer. 1 to 5 credits. A student may earn a maximum of 5 credits in all enrollments for this course.
R: Open only to master's degree students in Agricultural and Extension Education.
Master's Plan B Research.

899. *Master's Thesis Research*
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 99 credits in all enrollments for this course.
R: Open only to master's degree students in Agricultural and Extension Education.

901. *International Agricultural and Extension Education Systems*
Spring. 3(3-0)
P: AEE 801 or AEE 811 or AEE 821. R: Open only to graduate students in Agricultural and Extension Education.
Systems of agricultural and extension education in different countries. Philosophical and structural differences and similarities.

907. *Research Project Design and Implementation*
Spring. 3(3-0)
P: AEE 807 or approval of department.
Selection and development of research instruments. Quantitative and qualitative data analysis in agricultural and extension education.

911. *Nonformal Learning*
Fall of even-numbered years, Summer of odd-numbered years. 3(3-0)
P: AEE 811.
Theories and philosophies of learning in out-of-school settings. Alternative strategies.

912. *Advanced Extension Administration*
Spring. 3(3-0)
P: AEE 802. R: Open only to graduate students in College of Agriculture and Natural Resources.
Advanced practices and applications necessary for effective management and administration within extension education.

999. *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.
R: Open only to Ph.D. students in Agricultural and Extension Education.

AGRICULTURAL ECONOMICS AEC

Department of Agricultural Economics
College of Agriculture and Natural Resources

481. *Agricultural Research Systems in Developing Countries*
Summer. 2(2-0) Interdepartmental with Agriculture and Natural Resources, Animal Science, and Crop and Soil Sciences. Administered by Agriculture and Natural Resources.
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.

810. Institutional and Behavioral Economics
Fall. 3(3-0) Interdepartmental with Economics , and Resource Development.
Relationships among institutions, individual and collective actions, and economic performance. Public choice, property rights, and behavioral theories of firms and bureaucracies.

815. Applied Welfare Economics in Agriculture
Fall of odd-numbered years. 3(3-0)
P: EC 801; EC 805 or EC 812A; EC 809 or EC 813A.
Concepts and issues in welfare economics with application to agricultural development, policy and trade, marketing and finance, and environmental policy.

817. Political Economy of Agricultural and Trade Policy
Spring. 3(3-0)
P: EC 805 or EC 812A; EC 809 or EC 813A.
Concepts of policy analysis and decision. Agricultural sector problems, behavior, and policy in the development process. Macroeconomic and trade impacts. International policies affecting trade and development. Current policy issues.

820. Econometrics I
Spring. 3(3-0) Interdepartmental with Economics, and Statistics and Probability. Administered by Economics.
P: EC 801, STT 430.
The single equation regression model. Properties of least-squares estimators under various specifications. Multicollinearity, generalized least-squares, errors in variables, seemingly unrelated regressions. Identification and estimation in simultaneous equations models.

821. Econometrics II
Fall. 3(3-0) Interdepartmental with Economics, and Statistics and Probability. Administered by Economics.
P: EC 820, STT 442.
Estimation and hypothesis testing. Asymptotic properties of optimization estimators. Analysis of cross-sectional economic data. Qualitative and limited dependent variables. Probit, logit, tobit, and sample selectivity. Duration models. Count data.

822. Econometrics III
Spring. 3(3-0) Interdepartmental with Economics, and Statistics and Probability. Administered by Economics.
P: EC 820, STT 442.
Dynamic models and time series data. ARMA models. ARCH models. Unit roots, cointegration and error correction. Rational expectations models.

829. The Economics of Environmental Resources
Fall. 3(3-0) Interdepartmental with Resource Development, Forestry, Park and RecreationResources, and Economics.
Economic principles related to environmental conflicts and public policy alternatives. Applications to water quality, land use, conservation, development, and global environmental issues.

831. Food Marketing Management
Fall. 3(3-0) Interdepartmental with Marketing and Logistics. Administered by Marketing and Logistics.
P: ML 805 or approval of department. R: Open only to graduate students in Business or approval of department.
Marketing management decisions in food firms. Consumer orientation, computer technologies, food system cost reduction, global opportunities, environmental and social issues.

832. Environmental and Natural Resource Law
Fall. 3(3-0) Interdepartmental with Resource Development, Forestry, Crop and Soil Sciences, and Geography. Administered by Resource Development.
P: RD 430.
Origin and development of environmental law. Theories of power, jurisdication, sovereignty, property interests, pollution, and other bases for legal controls of natural resources. Common law and constitutional limitations on governmental power.

835. Introductory Econometrics
Summer. 3(3-0)
P: STT 430.
Estimation and interpretation of multiple regression models and their modifications when usual assumptions are not valid. Applications focus on problems faced by agricultural economists.

837. Water Law
Spring. 3(3-0) Interdepartmental with Resource Development and Forestry. Administered by Resource Development.
P: RD 430.
Legal principles applicable to surface water and groundwater, private and public water rights, and controls over water resources. Cases, statutes, and administrative procedures.

838. Land Use Law
Spring. 3(3-0) Interdepartmental with Resource Development, Forestry, and Urban Planning. Administered by Resource Development.
P: RD 430.
Public and private land use controls in the U.S. Civil rights, housing, energy problems, growth management, waste management, and land conservation. Cases, statutes and other regulations.

841. Organization and Performance of Agricultural Markets
Spring. 3(3-0)
R: Open only to graduate students in College of Agriculture and Natural Resources.
Analytical approaches. Institutions and processes for coordinating food and agricultural systems. Issues of organization, control and public policy.

845. Commodity Market Analysis
Fall. 3(3-0)
P: AEC 835.
Applied econometric analysis of commodity markets. Emphasis on specification and estimation of demand and supply models for forecasting. Modeling for policy evaluation. Futures and options markets. Microcomputer applications.

851. Agricultural Firm Management
Summer. 3(3-0)
Managerial processes for planning and controlling agricultural firms. Applications of financial concepts, budgets, simulations, and cognitive and information systems to developed and developing countries. Predictive and prescriptive analysis.

855. Agricultural Production Economics
Spring. 3(3-0)
P: EC 801, EC 805.
Agricultural applications of static production economics, including study of capital inputs that yield services over several time periods. Investment and disinvestment models. Methods for incorporating risk and technological change.

861. Agriculture in Economic Development
Fall. 3(3-0)
Role of agriculture in economic development of low- and middle-income countries. Theories of agricultural growth. Policy issues. Case studies.

865. Agricultural Benefit-Cost Analysis
Spring. 3(3-0)
Benefit-cost analysis of agricultural and natural resource projects, including financial and economic analysis. Case studies in project design and appraisal in low and high income countries.

890. Independent Study
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 8 credits in all enrollments for this course.
R: Open only to graduate students in Agricultural Economics. Approval of department.
Independent study of selected topics in agricultural economics.

891. Topics in Agricultural Economics (MTC)
Fall, Spring, Summer. 2 to 3 credits. A student may earn a maximum of 12 credits in all enrollments for this course.
R: Open only to graduate students in colleges of Agriculture and Natural Resources, Social Science and Business.
Selected topics such as agribusiness management, applied operations research, or rural development policy.

898. Master's Research
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course.
R: Open only to graduate students in Agricultural Economics. Approval of department.
Master's degree Plan B research.

899. Master's Thesis Research
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 99 credits in all enrollments for this course.
R: Open only to graduate students in Agricultural Economics. Approval of department.

923. Theory of Resource and Environmental Economics
Spring of even-numbered years. 3(3-0) Interdepartmental with Resource Development, Forestry, Park and Recreation Resources, and Economics.
P: AEC 829, EC 805.
Economic theory of environmental change and control. Market and non-market allocation mechanisms. Temporal issues of conservation and growth. Contemporary issues in research and policy.

947. Analysis of Food Systems Organization
Summer. 3(3-0)
P: AEC 810, AEC 841, AEC 845.
Public and private policy issues related to the organization and performance of food systems.

991. Advanced Topics in Agricultural Economics (MTC)
Fall, Spring, Summer. 2 credits. A student may earn a maximum of 12 credits in all enrollments for this course.
R: Open only to Ph.D. students in the colleges of Agriculture and Natural Resources, Business, and Social Science.
Topics such as international agricultural development, environmental economics, and trade policy.

992. Seminar in Agricultural Economics
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 3 credits in all enrollments for this course.
R: Open only to Ph.D. students in Agricultural Economics. Approval of department; application required.
Price analysis, development, risk, trade, dynamic modeling research methods, finance and environmental economics.

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.
t: 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.

460. 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.