

**Descriptions — Agricultural and Extension Education  
of  
Courses**

**826. Methods of Teaching Agricultural Mechanics**

Fall of odd-numbered years. 3(3-0)  
Approval of department.

Methods of instruction including program planning, scheduling, use of teaching aids, management of buildings, facilities and equipment; the selection, organization, and evaluation of activities in farm mechanics.

**828. Teaching Farmer Classes in Agriculture**

Fall of even-numbered years. 3(3-0)  
Approval of department.

Objectives of adult education in agriculture, organizing and promoting classes, course planning, instructional procedures, follow-up and evaluation.

**830. Effective Communications in Agriculture**

Fall, Winter. 3(3-0)

Scientific writing for professional lay agricultural and natural resources publications; grant writing; organizing, preparing and delivery of professional scientific presentations.

**851. Program Administration and Supervision**

Spring of odd-numbered years. 3(3-0)  
ANR 806, EAD 851A.

Principles and practices for developing, supervising and administering agricultural and extension educational programs.

**858. Leadership Development in Agricultural and Extension Education**

Winter. 3(3-0) Approval of department.

Sociological and philosophical bases for leadership development for agricultural and extension education in a democratic society.

**860. Program Evaluation**

Summer of even-numbered years.  
3(3-0) AEE 820 or approval of department.

Principles of evaluating agricultural and extension education programs.

**881. Selected Topics**

Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 9 credits if different topics are taken. Approval of department.

Topics will be selected to meet needs of graduate students in agricultural and extension education.

**883. Readings and Independent Study**

Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 6 credits. Approval of department.

Study on an individual and group basis in the various areas of agricultural and extension education.

**885. Seminar**

Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits. Approval of department.

Studies and presentation of research in Agricultural and Extension Education.

**899. Master's Thesis Research**

Fall, Winter, Spring, Summer. 1 to 12 credits. May reenroll for a maximum of 12 credits. Approval of department.

**999. Doctoral Dissertation Research**

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**AGRICULTURAL ECONOMICS**

**AEC**

**College of Agriculture and Natural Resources**

**805. Agricultural Production Economics I**

Fall. 4(4-0) EC 324, PAM 370.

Economic principles of production. Analysis of inputs yielding services over several periods. Principles underlying present value models. Welfare economic concepts. Aggregation of firm results. Deriving production functions and process models.

**809. Institutions; Behavior and Performance**

Fall. 3(3-0) EC 324, EC 326; or approval of department.

Conceptual approaches to economic analyses of public policy issues and programs with emphasis on the relationships among institutions, behavior of participants and performance.

**810. Economics of Public Choice**

Winter. 3(3-0) Approval of department. Interdepartmental with the departments of Resource Development and Economics.

Economics of alternative institutions for collective action. Emphasis on property rights and natural resources. Public goods, externalities, non-marginal change, commonwealth, income and power distribution, grants, welfare criteria and market failure.

**831. Food Marketing Management**

Fall, Spring. 4(4-0) May reenroll for a maximum of 8 credits. Interdepartmental with and administered by the Department of Marketing and Transportation Administration.

Food industry adjustment to changing social, economic and internal company environment. Managerial principles and techniques applied to food processing and distribution. Student interaction with industry, labor and government representatives.

**835. Introduction to Econometrics**

Spring, Summer. 3(3-0) EC 325, STT 422; not open to students with credit in EC 836. Interdepartmental with and administered by the Department of Economics.

Specification, estimation and interpretation of economic models. Applications to empirical problems.

**837. Applied Operations Research**

Spring. 4(4-0) EC 324, PAM 370. Approval of department.

Use and interpretation of operations research techniques for problems encountered by agricultural economists. Emphasis on linear programming and its variations such as transportation models, network analysis, spatial equilibrium models.

**839. Topics in Dynamic Agricultural Economics**

Winter of even-numbered years. 3(3-0) AEC 837, MTH 480; EC 812B or EC 805A, EC 805B.

Intertemporal analysis of production, resources and investment problems. Firm growth theory, calculus of variations, Pontryagin's maximum principle and dynamic programming. Emphasis on applications and economic interpretation.

**841. Industrial Organization of Agricultural Markets**

Spring. 3(3-0) EC 324, a junior-level course in agricultural marketing.

Conceptual and analytical approaches to identify and assess market performance. Institutions and market processes for coordinating agricultural systems. Issues of organization, control, and public policy.

**843. Commodity Market Analysis**

Fall. 3(3-0) EC 835 or approval of department.

Projecting short- and long-run demand, supply and prices of agricultural commodities. Data collection, model development and use of computers for understanding and measuring market dynamics. Futures and options markets.

**850. Agricultural Production Management in Developing Countries**

Winter. 3(3-0) EC 324 or approval of department. Not open to students with credit in FSM 430.

Farm management applications of comparative analysis, forward planning, budgeting, cash flow analysis and computer-aided decision making. Principles illustrated with developing country case studies.

**851. Farm Management**

Summer of even-numbered years. 3(3-0) FSM 430 or AEC 850 or approval of department.

Managerial processes for problem solving, planning and controlling. Review of decision literature in cognitive and information sciences. Budgeting, optimizing, scenario and stochastic simulation for predictive and prescriptive purposes.

**853. Decision Support Systems for Agriculture**

Fall of even-numbered years. 3(3-0) AEC 850; AEC 851 recommended.

Development and design of information systems. Database and modelbase systems with emphasis on decision maker/information systems interfaces. Analyses of systems using case studies.

**860. Agricultural Policy in Developed Economies**

Winter. 3(3-0) FSM 421, EC 324, EC 326; or approval of department.

Economic behavior of agricultural sector in advanced economies. Macroeconomic impacts. Evolution of sector problems and policy. Power structure and decision processes. Current issues in food and fiber policy.

**861. Agricultural Trade Policies**

Fall of odd-numbered years; Summer of even-numbered years. 3(3-0) EC 324, EC 326; or approval of department.

International trade in agricultural products, areas of competition, changes in comparative advantage, interrelationship of national and international policy regional groupings, trade and economic development, current policy proposals.

**862. Agriculture in Economic Development**

Winter. 3(3-0) EC 324, EC 326, PAM 462; or approval of department.

Agricultural and industrial sector interactions in the development process, examined from both historical and theoretical perspectives. Theories and models of the agricultural development process. Policy issues in agricultural development.

- 863. Benefit Cost Analysis**  
Spring. 3(3-0) AEC 805 or AEC 850 or approval of department. Interdepartmental with the Department of Resource Development. 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.
- 868. Data Collection and Analysis in Developing Countries**  
Spring of even-numbered years, Summer of odd-numbered years. 3(3-0) STT 422, one year of graduate study; or approval of department.  
Conducting farm/household/firm level studies of production and marketing. Preparing research proposals. Methodologies for data collection, processing, and analysis. Microcomputer applications. Field research administration. Statistical systems in developing countries.
- 876. Statistical Inference in Economics I**  
Fall. 3(3-0) EC 812A or EC 805A; STT 443 or STT 863; or approval of department. Interdepartmental with the departments of Economics, and Statistics and Probability. Administered by the Department of Economics.  
Review and extension of single-equation regression models. Properties of least-squares estimators under alternative specifications. Problems of analyzing nonexperimental data. Errors in variables, autoregressive and heteroscedastic models.
- 877. Statistical Inference in Economics II**  
Winter. 3(3-0) EC 876 or approval of department. Interdepartmental with the departments of Economics, and Statistics and Probability. Administered by the Department of Economics.  
Specification interpretation and estimation of simultaneous equation models. Nonlinear models. Bayesian approach to estimation problems. Recent developments in econometrics.
- 878. Statistical Inference in Economics III**  
Spring. 3(3-0) EC 877 or approval of department. Interdepartmental with the departments of Economics, and Statistics and Probability. Administered by the Department of Economics.  
Validation and application of dynamic econometric models. Bayesian approach to estimation problems. Recent developments in econometric methods and in applied econometric research.
- 882. Independent and Supervised Study**  
Fall, Winter, Spring, Summer. 1 to 12 credits. May reenroll for a maximum of 12 credits. Approval of department.  
Arranged seminars initiated by faculty or students; supervised readings; individual study of special problems.
- 889. Master's Research**  
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 6 credits. Approval of department.  
Master's degree Plan B research paper.
- 899. Master's Thesis Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
- 910. Resource Economics Proseminar**  
Spring of odd-numbered years. 3(3-0) May reenroll for a maximum of 9 credits. Approval of department. Interdepartmental with the departments of Forestry, and Resource Development. Administered by the Department of Forestry.  
A seminar wherein advanced graduate students in the fields of resource economics participate with faculty in the joint conduct of a major research project in resource economics and policy.
- 911. Public Program Analysis**  
Spring. 3(3-0) AEC 863, EC 805A, EC 805B; or approval of department. Interdepartmental with the departments of Economics and Resource Development.  
Policy aspects of nonmarket value estimation, shadow pricing, time preference, and risk analysis applied to systematic choice of agricultural, natural and human resource regulatory and public investment programs.
- 916. Development Administration**  
Fall of odd-numbered years. 3(3-0) Interdepartmental with and administered by the Department of Political Science.  
Design and organization of policies, programs and projects for Third World socioeconomic development. Effect of politics and culture on organizational performance. Public management process from planning to evaluation.
- 941. Seminar in Food Systems Organization and Policy**  
Summer. 3(3-0) AEC 809, AEC 841, AEC 843; or approval of department.  
Professional role simulation. Analysis under time pressure. Oral and written presentations in defense of positions on problems of market organization and related policy issues confronting agricultural economists.
- 972. Methodological Approaches to Research**  
Fall of even-numbered years, Summer of odd-numbered years. 3(3-0) Two terms of graduate study in social science or approval of department. Interdepartmental with the Department of Economics.  
Selection, planning and conduct of research. Alternative research approaches. Role of theory, beliefs and valuations. Critical appraisal of research studies.
- 990C. Mathematical Economics and Econometrics Workshop**  
Fall, Winter, Spring. 3 to 16 credits. EC 812A, EC 832, or approval of department. Interdepartmental with and administered by the Department of Economics.  
Critical evaluation of research reports by staff and other students. Students writing doctoral dissertations in the appropriate areas are encouraged to enroll in the workshop.
- 995. Advanced Topics**  
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 9 credits. Approval of department.  
Topics include agricultural marketing and price analysis, farm management, international agricultural development, production economics, public policy and resource economics.
- 999. Doctoral Dissertation Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
- Food Systems Economics and Management** **FSM**
- 200. Introduction to Food Systems Management**  
Fall. 4(4-0)  
Organization of modern industrialized food production and distribution systems. Problems faced by managers of firms in food systems. Application of economic and management principles in the solution of these problems.
- 330. Food Production Management**  
Fall, Spring. 3(3-0)  
Problems encountered by managers of farms and input supply firms. Identification and evaluation of alternative solutions using economic principles, financial statements and budgeting.
- 335. Food Marketing Management**  
Winter. 3(3-0) FSM 200 or MTA 300. Interdepartmental with and administered by the Department of Marketing and Transportation Administration.  
Analysis of problems in the food processing and distribution system. Functional interrelationships, consumer orientation and future development.
- 350. Fruit Marketing Economics**  
Fall of odd-numbered years. 3(3-0).  
Fruit grower marketing-management decisions; fruit marketing systems; pricing, marketing problems, improved marketing; demand expansion, marketing orders, bargaining, processing, marketing co-operatives; other policy alternatives.
- 370. Applied Statistics**  
Winter. 3(3-0) One course in statistics, one course in food systems economics and management or public affairs management. Interdepartmental with and administered by Public Affairs Management.  
Interpretation and use of statistical results in decision making. Sampling, index numbers, tabular analysis, trend estimation, regression models, decision theory.
- 412. Financing the Food System**  
Winter. 3(3-0) FSM 330.  
Financial analysis of farm businesses. Financial markets and credit institutions affecting agriculture. Capital budgeting of durable investments. Property valuation and financial leasing.
- 417. Land Economics**  
Fall, Spring. 4(4-0) EC 201. Interdepartmental with Public Affairs Management and the departments of Economics, and Resource Development. Administered by the Department of Resource Development.  
Factors affecting the economic use of land. Input-output relationships, development, property rights, zoning and land use controls, public land. Application of economic principles to selected land use policies.
- 418. Livestock Product Marketing**  
Spring. 4(3-3) ANS 110, FSM 200. Interdepartmental with and administered by the Department of Animal Science.  
Structure and product values in livestock market channels. Field study analysis of alternative marketing strategies, futures marketing, and the components of the livestock marketing chain. Field trips required.

**Descriptions — Agricultural Economics of Courses**

**421. Public Policy and the Food System**  
 Spring. 3(3-0) FSM 200 or EC 201, PAM 320 recommended. Interdepartmental with Public Affairs Management.

Policy issues identified and analyzed in relation to performance goals of society and groups within the food system. Emphasis on price and income policies and regulations affecting the food system.

**430. Advanced Food Production Management**  
 Spring. 3(3-0) FSM 412.

Management applied to farms and input supply firms; computerized applications of budgeting and forward planning, income tax management, estate management, insurance, and risk and uncertainty.

**439. Advanced Food Processing and Distribution Management**  
 Fall. 3(3-0) MTA 335. Interdepartmental with and administered by the Department of Marketing and Transportation Administration.

Managerial principles and techniques applied to food processing and distribution. Emphasizes adjustment to changing social, economic and internal company environment. Student interaction with industry, labor and government representatives. Field trips, special projects.

**441. Commodity and Futures Marketing**  
 Spring. 3(3-0) STT 201, EC 201; FSM 370 or STT 317 recommended.

Commodity pricing and use of marketing alternatives. Special emphasis on the futures markets and the institutional arrangements useful to farmers, elevator operators and commodity traders.

**443. Cooperatives: Group Action in Marketing**  
 Spring. 3(3-0) EC 201 or EC 202, Juniors or approval of department.

Organization and operation of cooperatives. Emphasis on economics, legal foundations, and feasibility of cooperatives and other forms of group action in the U.S. food system.

**460. Regional Economics**  
 Winter. 4(4-0) R D 417 or EC 324. Interdepartmental with Public Affairs Management and the departments of Economics, and Resource Development. Administered by the Department of Resource Development.

Forces affecting location decisions of firms, households and governments. Applications to agricultural, industrial, and regional developments.

**461. Regional Economics Laboratory**  
 Spring. 1(0-2) R D 460 and approval of department. Interdepartmental with Public Affairs Management and the departments of Economics and Resource Development. Administered by the Department of Resource Development.

Evaluation and use of analytical models designed to solve regional economic problems.

**462. Agriculture and Rural Development in Developing Nations**  
 Fall. 3(3-0) PAM 201 or EC 201; PAM 260 recommended. Interdepartmental with Public Affairs Management and Agriculture and Natural Resources.

Traditional agricultural systems and the incentive environment for economic growth in rural areas. Adjustment to technological, institutional and human change. Strategies for rapid agricultural transformation.

**480. Independent and Supervised Study**  
 Fall, Winter, Spring, Summer. 1 to 9 credits. May reenroll for a maximum of 9 credits. Approval of department.

**Public Affairs Management PAM**

**201. Introduction to Community Economics**  
 Fall, Spring. 3(3-0)

Identification and analysis of problems faced by public decision makers in managing public revenues and services and governing private resource use. Impact of political and economic structures on resource use.

**260. World Food, Population and Poverty**  
 Winter. 3(3-0)

Description, analysis and alternative solutions of food, technology transfer, population and poverty problems, emphasizing trade and aid programs and the role of multinational firms in low income nations.

**306. Government Programs for Workers**  
 Winter, Spring. 4(4-0) EC 201. Interdepartmental with and administered by the Department of Economics.

Economics of selected government institutions and programs for workers. Social security, worker's compensation, Unemployment Insurance, OSHA, employment and training programs, wages and hours legislation, anti-discrimination programs.

**320. Economic Policy Processes I**  
 Fall. 3(3-0) PAM 201 or EC 201.

Analysis of processes by which public economic policy is established at various levels of government. Role of economic interests and pressures. Alternative processes for economic policy formulation. Case studies.

**321. Economic Policy Processes II**  
 Winter. 3(3-0) PAM 320 or approval of department.

Analysis of socioeconomic forces as they affect the public decision processes for economic policy. Means of increasing effectiveness of staff persons in the decision process. Case studies.

**345. Methods in Policy Analysis**  
 Spring. 3(3-0) PAM 320, PAM 370; PAM 346 concurrently.

Analytical techniques in economics, mathematics, operations research, and systems analysis for problem solving in public affairs management.

**346. Computer Application in Policy Analysis**  
 Spring. 1(1-0) CPS 100; PAM 345 concurrently.

Application of computer software to problems in public affairs management.

**363. Economic Development of Tropical Africa**  
 Spring. 3(3-0) EC 201, EC 202 or EC 210. Interdepartmental with and administered by the Department of Economics.

African economic development in historical perspective. Analysis of contemporary economic development problems faced by tropical African countries. Alternative strategies for African economic development.

**370. Applied Statistics**  
 Winter. 3(3-0) One course in statistics, one course in food systems economics and management or public affairs management. Interdepartmental with Food Systems Economics and Management.

Interpretation and use of statistical results in decision making. Sampling index numbers, tabular analysis, trend estimation, regression models, decision theory.

**404. Public Program Evaluation**  
 Winter. 3(3-0) PAM 320 or approval of department.

Design and use of program evaluations in public management and budgeting. Social indicators and measures of quality of life.

**406. Public Expenditure: Theory and Policy**  
 Fall, Spring. 4(4-0) EC 201 or EC 210. Interdepartmental with and administered by the Department of Economics.

Expenditure theory; objectives and rationale of government activity in the market system; efficiency criteria in government decision making; planning-programming-budgeting systems and cost-benefit analysis.

**417. Land Economics**  
 Fall, Spring. 4(4-0) EC 201. Interdepartmental with Food Systems Economics and Management and the departments of Economics, and Resource Development. Administered by the Department of Resource Development.

Factors affecting the economic use of land. Input-output relationships, development, property rights, zoning and land use controls, public land. Application of economic principles to selected land use policies.

**419. Special Topics in Resource Economics and Policy (MTC)**  
 Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 12 credits if different topics are taken. EC 201, EC 202, approval of department. Interdepartmental with and administered by the Department of Resource Development.

Theoretical and applied topics in natural resource economics and policy.

**421. Public Policy and the Food System**  
 Spring. 3(3-0) FSM 200 or EC 201, PAM 320 recommended. Interdepartmental with and administered by Food Systems Economics and Management.

Policy issues identified and analyzed in relation to performance goals of society and groups within the food system. Emphasis on price and income policies and regulations affecting the food system.

**431. Law and Social Change**  
 Fall, Spring. 3(3-0) GBL 430 or approval of department. Interdepartmental with and administered by the Department of Resource Development.

Law as applied to urban and rural context of social change. A review of both formal and informal aspects of system accessibility, institutional formation, government, civil rights, and human service.

**453. Women and Work: Issues and Policy Analysis**  
 Winter. 3(3-0) PAM 201 or EC 201 or EC 202 or approval of department. Interdepartmental with the Department of Economics.

Quantity and quality of labor force participation by women, current status and past trends. Issues analyzed include differential earnings and occupations of men and women, employment discrimination and labor legislation.

**460. Regional Economics**  
Winter. 4(4-0) R D 417 or EC 324.  
*Interdepartmental with Food Systems Economics and Management and the departments of Economics and Resource Development. Administered by the Department of Resource Development.*

Forces affecting location decisions of firms, households and governments. Applications to agricultural, industrial, and regional developments.

**461. Regional Economics Laboratory**  
Spring. 1(0-2) R D 460 and approval of department. *Interdepartmental with Food Systems Economics and Management and the departments of Economics and Resource Development. Administered by the Department of Resource Development.*

Evaluation and use of analytical models designed to solve regional economic problems.

**462. Agricultural and Rural Development in Developing Nations**

Fall. 3(3-0) PAM 201 or EC 201; PAM 260 recommended. *Interdepartmental with Agriculture and Natural Resources, and Food Systems Economics and Management. Administered by Food Systems Economics and Management.*

Traditional agricultural systems and the incentive environment for economic growth in rural areas. Adjustment to technological, institutional and human change. Strategies for rapid agricultural transformation.

**480. Independent and Supervised Study**  
Fall, Winter, Spring, Summer. 1 to 9 credits. *May reenroll for a maximum of 9 credits. Approval of department.*

**490. Supervised Field Experience**  
Fall, Winter, Spring, Summer. 3 to 9 credits. *May reenroll for a maximum of 9 credits. PAM Juniors, approval of department.*

Supervised field work in federal, state, or local government or organizations dealing with government.

**495. Senior Seminar in Policy Analysis**  
Spring. 2(2-0) PAM 320, PAM 321, PAM 404.

Practicum on planning, performing and presenting studies of public policy issues. Supervised group projects on current local or state policy issues.

## **AGRICULTURAL ENGINEERING A E**

### **College of Agriculture and Natural Resources College of Engineering**

**152. Introduction to Agricultural Engineering**  
Winter. 1(1-0)

An introduction to the agricultural engineering profession with an examination of existing problems.

**352. Heat and Mass Transfer in Biological Processing**  
Winter. 4(4-0) CEM 361 or M E 311 or CHE 311.

Basic scientific principles and engineering theory applied to biological systems and products.

**353. Engineering Principles of Plant Environment**  
Fall. 4(4-0) CPS 112, MTH 310; CEM 152 or CEM 143.

Physical processes and properties of the biosphere as related to engineering the plant environment.

**354. Thermodynamic Applications in Biological Processes**  
Spring. 3(3-0) A E 352.

Psychrometrics and refrigeration. Engineering applications in animal production and food processing. Environmental control.

**356. Electric Power and Control**  
Winter. 4(3-2) PHY 288.

Alternating current calculations; sizing conductors of single- and three-phase loads; electric motors, their control and protection; switching logic; microprocessor applications. Examples drawn from agricultural applications.

**374. Principles of Food and Agricultural Machines**  
Spring. 4(3-2) C E 321 or CHE 340; MMM 306.

Physical properties of biological materials. Soil tillage. Metering, distribution, atomization, separation, conveying fluidization, and other physical processes performed by food and agricultural machines.

**376. Food Process Engineering**  
Spring. 3(2-2) A E 352, C E 321.

Analysis of unit processes involved in handling, processing, and distribution of liquid and solid biological materials. Flow of liquids, heating and cooling, freezing, concentration, dehydration, and separation.

**394. Systems of Agricultural Machines**  
Fall. 4(3-2) MMM 211.

Functional requirements and operational characteristics of agricultural machines. Engineering principles of machines dealing with soil and plant materials. Aspects of agricultural machinery management and economics.

**410. Professional Ethics and Responsibilities**  
Spring. 1(2-0) Senior majors.

Personal and professional ethics and social responsibilities will be addressed as related to the engineering profession.

**461. Design of Agricultural Structures**  
Fall. 4(4-0) MMM 211, MMM 215.

The analysis of structural systems and the design of components and connections. Examples selected from agricultural machinery and buildings.

**474. Processing Biological Products**  
Spring. 3(3-0) A E 352, M E 311 or CEM 361.

Engineering principles of unsteady-state heat transfer, heat exchangers, drying, storage and refrigeration as applied to the processing of biological products.

**480. Special Problems**  
Fall, Winter, Spring, Summer. 1 to 5 credits. *May reenroll for a maximum of 5 credits. Approval of department.*

Individual student research and study in: agricultural machines and tractors, waste management, food processing, structures and environment, materials processing and handling, water management, meteorology and climatology, agricultural systems analysis.

**481. Soil and Water Conservation Engineering**  
Winter. 4(5-0) C E 321, A E 353.

Engineering analysis, design and construction of drainage, irrigation and erosion control systems.

**482. Irrigation Design Management**  
Spring. 4(3-2) A E 481.

Water supply including wells, water transport, pumping and pump selection, water requirements, power supplies and irrigation equipment with emphasis on sprinkler and trickle methods and design for agricultural application.

**486. Fundamentals of Design Methodology**  
Fall. 2(2-0) A E 374, Seniors.

Concepts, methods, and procedures uniquely associated with the design process. Emphasis is on the total design process from problem identification to final specifications.

**490. Special Topics in Agricultural Engineering**

Fall, Winter, Spring, Summer. 1 to 4 credits. *May reenroll for a maximum of 12 credits if different topics are taken. Approval of department.*

Design topics in agricultural engineering such as food process engineering, machinery systems, structures, soil and water systems.

**492. Tractors and Power Transmission Systems**  
Winter. 4(4-0) A E 394.

Functional requirements, operational characteristics, analysis and design of tractors including power trains, hydraulics, traction, hitches, vehicle dynamics and operator comfort.

**493. Power and Control Hydraulics**  
Winter. 4(3-2) CPS 112, C E 321.

Properties of hydraulic fluids; performance parameters of fixed and variable displacement pumps and motors; characteristics of control valves and components; analysis and design of hydraulic systems.

**494. Food Process Engineering**  
Fall. 3(3-0) C E 321, A E 376.

Design of fluid handling equipment, mixers, and freezing systems for food.

**495. Fundamentals of Design**  
Fall. 3(3-0) Senior majors or approval of department.

Problem identification, working media, models, procedures, and developing specifications. Selection of individual design problems for A E 496.

**496. Design Project Laboratory**  
Fall, Winter, Spring, Summer. 1 to 4 credits. *May reenroll for a maximum of 4 credits. A E 495.*

Individual or team pursuit of the design project selected in A E 495. Activities include information expansion, developing alternatives, evaluation and selection, and concluding project.

**809. Finite Element Method**  
Fall, Winter, Spring. 4(4-0) Approval of department. *Interdepartmental with the departments of Metallurgy, Mechanics, and Materials Science; and Civil Engineering. Administered by the Department of Metallurgy, Mechanics, and Materials Science.*

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**  
Winter. 3(3-0) Approval of department.

Topics will be presented pertaining to thermodynamics, heat and mass transfer, thermal processing, fluid flow, dehydration and freeze drying of biological products or biological processes.