

422. National Defense Policy and Military Justice
Spring. 3(3-1)
Broad range of American civil-military relations and the environmental context in which defense policy is formulated. Military justice and the laws of war.

499. Independent Study
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 6 credits. Juniors and approval of instructor.
Investigation of an aspect of aerospace activities of specific interest to the student and a faculty member.

AFRICAN LANGUAGES

See Linguistics and Germanic, Slavic, Asian and African Languages.

AGRICULTURE AND EXTENSION EDUCATION

AEE

(Name change effective July 1, 1983. Formerly Agriculture and Natural Resources Education Institute.)

College of Agriculture and Natural Resources

360. Developing Concurrent Work-Education Programs
Fall. 1(2-0) Approval of department.
Planning, organizing and implementing effective concurrent work-education programs for secondary vocational agribusiness and natural resources education students.

361. FFA in Agribusiness and Natural Resources Education
Winter. 1(2-0) Approval of department.
Planning and organizing an effective FFA program as an integral part of a secondary vocational agribusiness and natural resources education program.

362. Developing a Five-Year Plan
Spring. 1(2-0) Approval of department.
Developing and organizing a five-year plan for a comprehensive secondary vocational agribusiness and natural resources education program.

401. Agriculture and Natural Resources Communications
(ANR 401.) Fall, Winter, Spring. 3(2-2) JRN 201 or other writing course and approval of department.
Techniques, strategies and practices in development of agricultural and natural resources information programs. Including writing, public relations, TV and radio production for specialized and general audiences.

402. Agriculture and Natural Resources Communications Internship
(ANR 402.) Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 6 credits. AEE 401, approval of department.
Internship with professionals in communications field with emphasis on student's areas of interest—writing, radio, TV, publications, etc.

483. Readings and Independent Study
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 6 credits. Juniors; approval of department.
Study on an individual basis in the various areas of emphasis in agricultural and extension education.

826. Methods of Teaching Agricultural Mechanics
(ED 830G., ANR 826.) 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
(ED 828B., ANR 828.) 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.

AGRICULTURAL ECONOMICS

AEC

College of Agriculture and Natural Resources

805. Agricultural Production Economics I
Fall. 4(4-0) PAM 340 or EC 325.
Economic principles of production. Industry supply and factor demand analysis. Management concepts and choice criteria. Interrelationship of production and consumption decisions. Welfare economics. Agricultural economics applications.

809. Institutions; Behavior and Performance
Fall. 3(3-0) Approval of department.
Relationships among institutional structure, behavior, and performance. Concepts of behavioral sciences useful in public policy and program analysis emphasizing interactions of preferences, incentives and institutions.

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.

811. Public Program Analysis
Spring. Summer of odd-numbered years. 3(3-0) EC 324 or approval of department. Interdepartmental with the departments of Economics and Resource Development.
Application of benefit-cost analysis to public programs of resources development. Issues and case studies in budgeting, investment criteria, pricing, externalities, and coordination.

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 I
Spring. 4(4-0) MTH 113 or MTH 228. 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.

838. Applied Operations Research II
Summer. 2(2-0) MTH 113 or MTH 228, STT 422. Approval of department.
Use and interpretation of operations research techniques for problems encountered by agricultural economists. Emphasis on techniques such as Markov processes, dynamic programming cohort analysis, queuing, Monte-Carlo techniques, elementary simulation.

841. Industrial Organization of Agricultural Markets
Fall. 3(3-0) Approval of department.
Market organization and evaluation of performance. Pricing and market coordination problems. Group action in agricultural markets. Role of marketing in economic development.

843. Commodity Market Analysis
Winter. 3(3-0) STT 422, EC 325.
Economic forecasting in agricultural commodity markets, short run and long run. Futures markets, hedging, speculation. Plant location and size. Selected topics. Emphasis on techniques of use to firm manager.

851. Advanced Farm Management
Summer. 3(2-2) FSM 430 or approval of department.
Emphasizes identification, analysis, and methods of solving problems of farm organization and operation; new technology, specialization and scale. Farm case studies, role-playing, computer games and farm business simulation.

860. Rural Welfare and Development Policy
Spring. 3(3-0) Approval of department.
Analysis of policies and programs for U.S. rural economic and human development. Development strategies. Public decision processes. Growth and distribution of income and public services. Poverty and income maintenance.

**Descriptions — Agricultural Economics
of
Courses**

861. Agricultural Trade Policies

Fall of odd-numbered years; Summer of even-numbered years. 3(3-0) EC 428 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) PAM 462 or approval of department.

Agricultural and industrial sector interactions in the development process. Theories and models of the agricultural development process. Transformation of agriculture in less-developed countries.

865. Rural Development Administration

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

Concepts and principles of development administration and their application in the analysis of the processes and structures through which rural development activities are formulated and implemented in less developed countries.

868. Data Collection in Developing Countries

Spring of even-numbered years, Summer of odd-numbered years. 3(3-0) AEC 830 or STT 825 or approval of department.

Principles for conducting household/village level studies of production and marketing in developing countries. Preparing research proposal, methodologies for data collection, processing and analysis. Field research administration.

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.

884. Selected Topics

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

899. Master's Thesis Research

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

906. Agricultural Production Economics II

Winter. 4(4-0) AEC 805.

Resource allocation and efficiency in agriculture as related to management under conditions of both perfect and imperfect knowledge of price, institutional, technological and human change. Advanced topics.

910. Resource Economics Proseminar

Spring. 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.

941. Seminar in Food Systems Organization and Policy

Spring of odd-numbered years, Summer of even-numbered years. 3(3-0) Approval of department.

Alternative methods of organization and control of food systems. Policy and program analysis. Development and presentation of position papers.

960. Agricultural Policy in Developed Economies

Winter. 3(3-0) FSM 421 and one year of graduate work in social science or approval of department.

Sectoral interrelationships and the impact of economic policies relating to agriculture in advanced economies. Public decision processes. Current issues in food and fiber policy.

962. Development Planning and Agricultural Sector Analysis

Spring. 3(3-0) AEC 862; one year of graduate study in agricultural economics or economics or approval of department.

Seminar in development planning with special reference to sectoral interrelationships. Agricultural sector analysis. Project preparation and appraisal.

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 participate in workshop and may do so while registered for AEC 999.

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 Processing and Distribution 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 faced in the food processing and distribution system. Includes functional interrelationships, consumer orientation and future development.

370. Applied Statistics

Winter. 3(3-0) Students may not receive credit in both FSM 370 and AEC 830. 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 or PAM 340.

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) Interdepartmental with Public Affairs Management and the departments of Resource Development, and Economics. Administered by the Department of Resource Development.

Factors affecting the economic use of land and space resources by people. Input-output relationships; development, investment, and enterprise location decisions. Land markets; property rights, area planning; zoning and land use controls.

421. Public Policy and the Food System
Winter. 3(3-0) FSM 200 or EC 201, PAM 320 recommended.

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 200, 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.

473. Introduction to Systems Analysis

Spring. 3(3-0) MTH 111. Interdepartmental with and administered by Public Affairs Management.

Principles of systems analysis applied to ecological, physical, economic and social phenomena. Case studies. Interpretation and design of systems models. Systems concepts in decision making.

480. Independent and Supervised Study

Fall, Winter, Spring, Summer. 1 to 9 credits. May reenroll for a maximum of 9 credits. Approval of department.

484. Selected Topics

Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 12 credits if different topics are taken. 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. 4(4-0)

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.

303. Welfare, Health and Education Policy

Fall. 3(3-0) PAM 201 or EC 200.

Evaluation of selected welfare health and education policies and alternatives. Role of public and private sectors. Impact of values, beliefs, costs, benefit distributions, political power and other factors on policy.

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.

340. Managerial Economics

Spring. 3(3-0) EC 201.

Production, consumption decisions and their interrelation. Pricing of market and non-market goods. Effects of monetary and fiscal policies. Applications to problems in food system or community management.

363. Economic Development of Tropical Africa

Spring. 3(3-0) EC 200 and EC 201, 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) Students may not receive credit in both FSM 370 and AEC 830. 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. Social Accounts and Community Choice

Winter. 3(3-0) PAM 303 or approval of department.

Social accounting as a framework for problem definition and measurement of policy effectiveness. Conceptualization of social accounts. Use of selected social indicators in policy formulation and decision making.

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) 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 and space resources by people. Input-output relationships; development, investment, and enterprise location decisions. Land markets; property rights, area planning; zoning and land use controls.

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.

**Descriptions — Agricultural Economics
of
Courses**

453. Women and Work: Issues and Policy Analysis
Winter. 3(3-0) PAM 201 or EC 200 or EC 201 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.

473. Introduction to Systems Analysis
Spring. 3(3-0) MTH 111. Interdepartmental with Food Systems Economics and Management.

Principles of systems analysis applied to ecological, physical, economic and social phenomena. Case studies. Interpretation and design of systems models. Systems concepts in decision making.

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

484. Selected Topics
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 12 credits if different topics are taken. 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.

**AGRICULTURAL
ENGINEERING A E**

**College of Agriculture and Natural
Resources**

152. Introduction to Agricultural Engineering
Fall, Spring. 1(1-0) Interdepartmental with Agricultural Engineering Technology.

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

352. Physical Principles of Biological Processes
Winter. 4(4-0) A E 353.

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

353. Physical Principles of Plant Environment
Fall. 4(4-0) CPS 120, MTH 310, CEM 152 or CEM 132.

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

354. Physical Principles of Animal Environment
Spring. 3(2-2) A E 352.

Interrelationship of environmental factors and physiological responses of animals for planning, design and control of optimum environmental systems.

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.

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 professions of engineering and engineering technology.

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.

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 120, 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.

495. Fundamentals of Design
Spring. 3(3-0) Third-term junior majors or approval of department.

Problem identification, working media, models, procedures, and developing specifications. Selection of individual design problem for A E 496 and A E 497.

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. 4(4-0) Approval of department. Interdepartmental with the Department 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.