

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) RD 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) RD 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

(471.) 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

(476.) 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

(494.) Fall. 3(3-0) MMM 306.

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(4-0) 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, 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.

**Descriptions – Agricultural Engineering
of
Courses**

- 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.

- 814. Physical Properties of Agricultural Products**
Winter. 3(3-0) Approval of department.

Physical and mechanical behavior of fruits and vegetables, forages, grains and other agricultural products under constant and dynamic loading. Related to design parameters for production, handling and processing machinery.

- 815. Instrumentation for Agricultural Engineering Research**
Spring. 3(3-0)

Theory, method and techniques of measuring temperature, pressure, flow, humidity, and moisture for biological materials. Associated recording and indicating equipment.

- 820. Research Methods in Agricultural Engineering**
Fall. 1(1-0)

Discussion of procedures for initiating, developing, carrying out, and completing research projects.

- 822. Seminar**
Spring. 1(1-0)

- 840. Advanced Power and Machinery**
Winter of even-numbered years. 3(2-2)
A E 394, A E 492.

Analysis of agricultural machine components and systems. Emphasis on hydraulic power transmission, controls, and management of machinery systems.

- 880. Special Problems**
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 9 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.

- 899. Master's Thesis Research**
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

- 999. Doctoral Dissertation Research**
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

Agricultural Engineering Technology AET

- 152. Introduction to Agricultural Engineering**
Fall, Spring. 1(1-0) Interdepartmental with and administered by the Department of Agricultural Engineering.

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

- 200. Computers and Information Processing in Agriculture and Natural Resources**
(A E 200.) Spring. 3(3-0)

Evaluation of the present and future role and application of electronic computers in the area of agriculture and natural resources.

- 201. Technical Agricultural Mechanics Skills**
(A E 402.) Fall. 3(2-3) Major or minor in vocational agriculture or major or minor in Agribusiness and Natural Resources Education or approval of department.

Basic principles, applications, techniques, tools, materials, and resources in agricultural mechanics skills.

- 202. Agricultural Metalworking**
(A E 202.) Winter. 3(2-2)

Principles, skills and safety for welding, soldering, brazing, cutting, bench work, metallurgy, fastening and shop tools. Maintenance metalworking for farm and agribusiness shops will be emphasized.

- 243. Automotive and Recreational Engines**
(A E 243.) Spring. 2(2-0)

The principles and maintenance of engines used in automobiles and recreational vehicles. Fuels, lubricants and emission control. Basic engineering principles are developed in a manner that requires no prior technical training.

- 244. Automotive and Recreational Engines Laboratory**
(A E 244.) Spring. 1(0-2) AET 243 or concurrently.

Laboratory experiences in engine maintenance. Ignition principles and testing equipment.

- 258. Technical Skills**
Fall, Winter, Spring. 1 to 7 credits. May reenroll for a maximum of 10 credits. Majors or approval of department.

Selection, operation, and maintenance of physical components of electrical, mechanical, environmental and water management systems in agriculture and natural resources industries, including system design and component installation.

- 322. Systems Analysis in Agricultural Production**
Fall. 3(3-0) MTH 111 or MTH 109, CPS 110 or CPS 120.

Simulation of processes and operations for food, feed, fiber and energy flow in agriculture and natural resources. Analysis of interrelationships between physical systems.

- 323. Mechanical Systems in Agriculture and Natural Resources**
Winter. 4(4-0) PHY 237, PHY 257.

Phenomenological aspects of the laws of mechanics and their influence on the design of mechanical and structural systems encountered in agriculture and natural resources.

- 324. Processing Systems for Biological Products**
Winter. 4(4-0) MTH 109 or MTH 111, PHY 237.

Physical processes which influence biological products during production, handling, processing and distribution. Mass and heat balances, fluid flow, steam generation, psychrometrics, heat exchange, refrigeration and dehydration will be discussed.

- 329. Unit Operation and Food Processing I**
Fall. 4(3-2) PHY 237, MTH 109. Interdepartmental with Food Science.

Engineering concepts related to the unit operations found in the food industry. Fluid mechanics, heat transfer and rate processes including psychrometrics and refrigeration.

- 341. Energy in the Food System**
Winter. 3(3-0) Juniors or approval of department. Interdepartmental with Agriculture and Natural Resources.

Energy flow in the food system. Conversion principles and processes—solar, engines, fertilizers, pesticides, electrical, waste heat utilization. Environmental considerations, economic and social implications related to the food system. Alternatives. Conservation.

- 401. Teaching Agricultural Mechanics**
(A E 402.) Spring. 3(2-3) AET 201; AET 202 or AET 243 and AET 244; ED 327A.

Teaching techniques in agricultural mechanics for secondary and vocational schools. Shop planning and management.

- 415. Agricultural and Natural Resources Safety**
Winter. 3(3-0) Juniors.

Principles of safety problem solving. Accident causation and prevention; laws and regulations; machinery, electrical, chemical, livestock, shop and fire safety; security; and safety program development.

- 416. Light Structural Systems**
Fall. 4(4-0) PHY 237 or approval of department.

Functional planning of animal structures. Properties of building materials and selecting building components to satisfy requirements of light structures.

- 421. Electrical Energy Utilization**
Spring. 4(3-2) PHY 238 or approval of department.

Efficient utilization of electrical energy; selection, operation and control of electrical equipment. Design of electrical systems.

- 431. Irrigation, Drainage and Erosion Control Systems**
Spring. 4(3-2) CSS 210 or approval of department.

Use of surveying, design, construction and cost estimates of drainage irrigation and water control systems.

- 443. Machinery and Tractor Systems**
Fall. 4(3-2) AET 243 or approval of department.

Characteristics of basic agricultural field machinery. Diesel engine, fuel injection and combustion chamber characteristics. Torque and power transmission, tractor stability and implement hitching.

- 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.

- 804. Agricultural Mechanization in Developing Countries**
(A E 804.) Spring. 3(3-0) Approval of department.

Appropriate agricultural mechanization with emphasis on hand, animal, and mechanical equipment for the smaller farms. Machine selection, local manufacturing, public and private costs, ownership patterns; increasing production and decreasing post production losses.

805. Environmental Measurements
(A E 805.) Fall. 4(3-3)

Methods and techniques for accurate measurement and interpretation of environmental parameters. Temperature, humidity, wind and air flow characteristics, radiation, light intensity, gaseous and particulate concentrations in atmospheric microclimates will be discussed.

806. Analysis of Agricultural Systems
(A E 806.) Winter. 3(3-0) SYS 810.

Identification and definition of systems problems in agriculture. Model formulation and estimation. Several models of current interest are considered.

807. Man-Machine Relationships
(A E 807.) Fall. 3(3-0) Approval of department.

Analysis of machine design, operation and working environment in relation to human limitations and capabilities, analysis of procedures used to develop maximum compatibility between man and machine.

899. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 15 credits. Approval of department.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 36 credits. Approval of department.

Building Construction B C

200. Dynamics of American Housing
Fall, Winter, Spring, Summer. 3(3-0)

Impact of housing on the economic and social welfare of America. Analysis of the residential building industry and its problems in providing adequate housing.

239. Housing Conservation
(A E 239, AET 239.) Spring. 3(3-0) Interdepartmental with the Department of Human Environment and Design.

Skills and techniques in conserving, repairing and remodeling existing housing. Structural components of housing and evaluation of housing structure.

312. Structural Design
Winter. 4(4-0) PHY 237.

Consideration of structural design systems as used in light construction.

412. Housing Utilities Design
Winter. 4(4-0) PHY 238, EGR 463 or approval of department.

Design of and planning for mechanical and electrical utilities in housing.

413. Residential Construction Systems

Spring. 4(3-2) PHY 239, B C 312 or approval of department.

Analysis of the primary construction systems employed in the residential building industry, especially the economic and social aspects in meeting the housing goals of the U. S.

415. Building Materials

Spring. 4(4-0) PHY 239, B C 312 or approval of department.

Properties of building materials pertinent to their application and performance in service.

416. Building Costs
Fall. 4(2-4) EGR 364 or approval of department.

Methods of cost estimating. Effects of codes and production practices on costs.

417. Residential Finance
Winter. 4(4-0) AFA 395 or approval of department.

Analysis of financial programs for the construction, rehabilitation, remodeling and purchase of homes; especially meeting the nation's goals for low to moderate income housing.

418. Special Problems
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 9 credits. Written approval of department.

Special problems in the areas of acquisition and development of residential land, design, construction technology, building materials, finance, marketing, construction management and land use codes and regulations.

420. Construction Management
Spring. 4(4-0) Senior majors or approval of department.

Systems management techniques for residential building organizations inclusive of organization development, operations, planning, scheduling and control, and administrative systems and procedures.

835. Research in Building Construction

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

880. Special Problems
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 9 credits. Approval of department.

Individual student research and study in land acquisition and development, design, construction, management, finance, marketing, and structural analysis.

899. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

AGRICULTURAL ENGINEERING TECHNOLOGY

See Agricultural Engineering.

AGRICULTURE AND NATURAL RESOURCES ANR

College of Agriculture and Natural Resources

220. Plants and Their Environment
(N R 220.) Winter. 3(3-0) Interdepartmental with and administered by the Department of Forestry.

Relationships between plants and fundamental climatic, edaphic, and biotic factors; structure and function of different ecosystems in relation to environmental factors.

275. Exploring International Agriculture
(AG 275.) Spring. 3(3-0)

Exploration of overseas assignments with international agencies; potential world food actualities and potentialities; special problems of the tropics compared with those in temperate regions.

280. Selected Topics
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 6 credits if different topics are taken. Approval of department.

341. Energy in the Food System
(AG 341.) Winter. 3(3-0) Juniors or approval of department. Interdepartmental with and administered by Agricultural Engineering Technology.

Energy flow in the food system. Conversion principles and processes—solar, engines, fertilizers, pesticides, electrical, waste heat utilization. Environmental considerations, economic and social implications related to the food system. Alternatives. Conservation.

350. Leadership Development for Agriculture and Natural Resources

(AG 350.) Winter, Spring. 3(3-0) May reenroll for a maximum of 6 credits. Approval of department.

Leadership development. Preparation for community leadership. Firsthand look at social, economic, and political problems. Series of seminars, interviews, field trips. Emphasis on awareness, action, and involvement. Field trips required.

399. Professional Internships in Agriculture and Natural Resources

(AG 399.) Fall, Winter, Spring, Summer. Zero to 10 credits. [10 credits.] Juniors and approval of department.

Professionalized experiences in a student's major. Supervision and evaluation by faculty and cooperating agencies.

401. Agriculture and Natural Resources Communications

(AG 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

(AG 402.) Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 6 credits. ANR 401, approval of college.

Internship with professionals in communications field with emphasis on student's areas of interest—writing, radio, TV, publications, etc.

410. Environmental Toxicology
(AG 410.) Winter. 4(4-0) B S 212, BCH 401. Interdepartmental with and administered by the College of Natural Science.

Fate and effects of toxic chemicals in soil, plants, wildlife, and aquatic systems. Interactions between chemicals and the environment which influence their fate and ecological importance.