

**962. Workshop on Planning and Implementation of Agricultural Development**

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

National planning problems with special reference to interrelationships between agricultural and industrial sectors in less developed countries. Regional and agricultural sector planning. Project preparation and appraisal. Implementation. Research for planning.

**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 Economics Department.

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 812, 832, or approval of department. Interdepartmental with and administered by the Economics Department.

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 999.

**999. Research**

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

**AGRICULTURAL ENGINEERING**

A E

**College of Agriculture and Natural Resources**

**202. Physical Principles of Mechanical Processes**

Fall, Spring. 3(1-4)

Theory and skills in metallurgy, heat treating, cold metal, sheet metal, plumbing, arc and oxy-acetylene welding and machine operations.

**220. Engineering Principles Applied to Agriculture**

Winter. 4(3-2) MTH 108.

Physical principles and their application to agricultural production, distribution and processing.

**352. Physical Principles of Biological Processes**

Fall. 3(3-0) MTH 215, PHY 289.

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

**353. Physical Principles of Plant Environment**

Winter. 3(3-0) 352, SLS 210.

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

**354. Physical Principles of Animal Environment**

Spring. 3(2-2) 352.

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

**402. Teaching Agricultural Mechanics**

Winter, Spring. 5(2-6) Juniors.

Teaching theory and developing skills in agricultural mechanics in secondary and vocational schools. School and farm shop planning and management. Emphasis on equipment and material selection, metallurgy, metal work and welding.

**416. Agricultural Structures**

Fall, Spring. 4(3-2) Juniors.

Functional planning and principles of environmental control, cost estimation, structural component analysis and properties of building materials.

**421. Electric Power**

Fall, Spring. 4(3-2) 220.

Application of electric energy to production and living; selection, installation, operation and control of electrical equipment.

**423. Principles of Processing Equipment**

Winter. 3(2-2) 220.

Principles of equipment used in the processing and storage of biological products.

**425. Farmstead Materials Handling**

Spring. 3(2-2) Juniors.

Systems and equipment for handling grain, hay, fertilizer, water and wastes on the farm. Systems design and evaluation.

**431. Principles of Irrigation, Drainage and Erosion Control**

Spring. 4(3-2) SLS 210.

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

**432. Introduction to Meteorology**

For course description, see Interdisciplinary Courses.

**433. Introductory Meteorology Laboratory**

For course description, see Interdisciplinary Courses.

**437. Principles of Food Engineering**

Winter. 5(5-0) 220.

Principles and use of electricity, steam, refrigeration and hydraulics in food plants. Emphasis will be placed on specialized processing equipment, their design features, materials of construction and automatic control.

**443. Internal Combustion Engines**

Fall, Spring. 3(2-2) 220.

Introduction to spark ignition and compression ignition engines with emphasis on principles of operation, combustion, fuels, lubricants and engine performance.

**444. Agricultural Production Machinery**

Spring. 3(2-2) 220.

Basic principles of agricultural machines. Selection, care and operation of agricultural machinery for obtaining optimum conditions for crop production.

**459. Special Problems**

Fall, Winter, Spring, Summer. 1 to 5 credits. May re-enroll for a maximum of 5 credits. Approval of department.

**461. Light Structure Analysis, Design and Synthesis**

Fall. 4(3-2) MMM 211.

Physical and chemical properties of engineering materials and interactions with bioclimatic conditions. Analysis and design of light structures. Functional planning and system synthesis.

**471. Electricity and Radiation**

Winter. 3(2-2) E E 345.

Characteristics, measurement and control of power and radiation in agriculture.

**474. Processing Biological Products**

Spring. 4(3-2) 352, M E 311.

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

**475. Introduction to Operations Research**

Winter. 4(4-0) MTH 215, CPS 120.

Interdepartmental with Systems Science. Methodology and basics of operations research; formulation and analysis of probabilistic models of inventory, waiting line, and reliability processes; random process simulation and network planning models.

**481. Soil and Water Engineering**

Spring. 5(4-2) M E 332.

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

**493. Energy Conversion Systems**

Spring. 4(3-2) M E 311.

Principles of energy conversion with emphasis on the internal combustion engine. Thermodynamic analysis, performance characteristics, and power transmission.

**494. Systems of Agricultural Machines**

Fall. 4(3-2) 353.

Systems of machines used in field and farmstead operations. Engineering principles for machines dealing with biological materials.

**804. Agricultural Mechanization in Developing Countries**

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

Principles of mechanical equipment selection for organized agricultural enterprises. Machinery specifications and standards, performance efficiency, cost and use, and management factors. Domestic and foreign considerations.

**805. Environmental Measurements**

Fall. 3(2-2)

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.

**811. Technical Problems**

Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 9 credits.

**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**

Fall. 3(3-0)

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

**817. Electronics in Agricultural Engineering**  
Spring. 3(2-3) E E 345 or PHY 419.  
Electronic and control circuits for agricultural industry and research. Analysis and development of measurement and control systems.

**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**  
Spring. 3(2-2) 493, 494.  
Analysis of agricultural machine components and systems. Emphasis on hydraulic power transmission, controls, and management of machinery systems.

**899. Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**990. Advanced Topics in Agricultural Engineering**  
Fall, Winter, Spring. 3(3-0) May re-enroll for a maximum of 9 credits. Approval of department.  
New developments in agricultural engineering. Subjects to be covered include atmospheric turbulence, optimization of agricultural systems, measurement systems, food engineering, and agricultural rheology.

**991. Soil Dynamics**  
Winter. 3(2-3) Approval of department.  
Dynamic soil strength. Soil stress and strain analysis of traction and tillage devices. Experimental techniques for traction and tillage studies.

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

**AGRICULTURE AG**  
**College of Agriculture and Natural Resources**

**450. United States Agriculture for Overseas Students**  
Fall. 3(3-0) Advanced undergraduate or graduate students from countries other than the United States or Canada.  
Orientation course for overseas students. Development of United States agriculture. Institutions serving agriculture with emphasis on Land Grant University system. Scientific developments and their impact on agriculture. Field trips.

**462. World Agriculture and Economic Development**  
Fall. Summer of even-numbered years. 3(3-0) AEC 240 or EC 201. Interdepartmental with and administered by the Agricultural Economics Department.  
Food and agricultural problems of the world. Role of agriculture in the process of economic development. Relationships of agricultural trade patterns, farming systems and economic growth.

**802. Agriculture Administration**  
Winter. 3(3-0) AEC 462 or approval of department.  
Administrative relationships and principles involved in agricultural development in the world's emerging countries. Case studies used to illustrate the process of change in institutions that serve agricultural economies in transition.

**803. Approaches to Accelerated Development**  
Spring. 3(3-0) 802 or approval of department.  
Examination of trained manpower needs and project priorities in agricultural and natural resource sectors. Alternative methods for organizing research and development. Case studies of national planning.

**AMERICAN STUDIES AMS**  
**College of Arts and Letters**

**301. Issues in American Civilization**  
Fall, Winter, Spring. 3(3-0) May re-enroll for a maximum of 9 credits. ATL 113. Not applicable to major requirements.  
Selected issues in American life past and present, with materials drawn from such disciplines as history, social sciences, philosophy, literature and the arts. Topics vary.

**410. Perspectives in American Studies**  
Fall. 3 credits. Juniors in American Studies or approval of American Studies Committee.  
Methods and significant works, for majors in the American Studies program. Offered by members of the relevant departments.

**411. Problems in American Civilization**  
Winter, Spring. 3 credits. Majors must re-enroll for a maximum of 6 credits. 410, Juniors in American Studies or approval of American Studies Committee.  
Seminar approach to selected problems in American life employing the objectives and approaches of interdisciplinary studies. Offered by members of relevant departments, for majors in the American Studies program.

**AMERICAN THOUGHT AND LANGUAGE ATL**  
**University College**

Alternative approaches or tracks are offered on an optional basis all of which meet the course objectives of 111, 112, 113. These are described briefly below and are designated by letters which are used as part of the course number for registration. No student may receive credit for more than one track within a course (111, 112, 113).

**100. Comprehensive English**  
(I S 095.) Fall, Winter, Spring, Summer. 3(4-0) Approval of department.  
Instruction and practice in reading and writing. Emphasis upon mastery of fundamental skills needed for a variety of reading and writing assignments.

**111. American Thought and Language**  
Fall, Winter, Spring, Summer. 3(3-0) Satisfactory grade on English proficiency examination or ATL 100.

A. Aims to improve the student's ability to read and write and to acquaint him with his American heritage. Reading is in selected historical, social, and literary documents.  
H. Adaptation of the regular program for honors students.

**112. American Thought and Language**  
Fall, Winter, Spring, Summer. 3(3-0) Three credits in a 111 track.  
A. Aims to improve the student's ability to read and write and to acquaint him with

his American heritage. Reading is in selected historical, social, and literary documents.  
B. Whole books approach to regular program.  
C. Emphasizes American humanities approach to regular program.  
H. Adaptation of regular program for honors students.

**113. American Thought and Language**  
Fall, Winter, Spring, Summer. 3(3-0) Three credits in a 112 track.  
A. Aims to improve the student's ability to read and write and to acquaint him with his American heritage. Reading is in selected historical, social, and literary documents.  
B. Whole books approach to the regular program.  
C. American humanities approach to the regular program.  
H. Adaptation of regular program for honors students.

**300. Supervised Individual Study**  
Fall, Winter, Spring. 1 to 4 credits. 113; approval of department.  
Selected students requesting individual study of interdisciplinary problems will work under supervision of University College professors. Variable elective credit will be determined when the student secures instructor, adviser, and department approval.

**ANATOMY ANT**  
**College of Human Medicine  
College of Veterinary Medicine**

**316. General Anatomy**  
Fall, Spring. 5(5-0) N S 193.  
Designed to impart the basic concepts of the broad field of anatomy. Special requirements of the various disciplines will be met in their respective laboratories.

**401. Undergraduate Seminar**  
Fall, Winter, Spring. 1 credit.  
**413. Problems in Anatomy**  
Fall, Winter, Spring, Summer. 1 to 2 credits. May re-enroll for a maximum of 6 credits. Approval of department.  
Additional study in one or more of the various fields of anatomy such as gross anatomy, histology, hematology and embryology.

**420. Microscopic Anatomy and Embryology**  
(305A.) Fall. 5(2-8) Medical Technology students or approval of department.  
Course 420 devoted to microscopic structure of cells and tissues and beginning embryology; 421 to structure of organs and systems and completion of embryology.

**421. Microscopic Anatomy and Embryology**  
(305B.) Winter. 5(2-8) 420.  
Continuation of 420.

**521. Gross and Microscopic Anatomy**  
Fall, Spring. 9(4-14) First-term Veterinary Medicine students; approval of department for graduate students.  
Gross anatomy of a representative animal, the dog, is studied. Cytology, embryology, comparative histology, neuroanatomy and organology are combined with dissection, demonstration and practical applications to give complete coverage.

**522. Gross and Microscopic Anatomy**  
Winter, Summer. 9(5-11) 521.  
Continuation of 521.