

**AGRICULTURAL
ENGINEERING**

A E

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

- 152. Introduction to Agricultural Engineering**
Winter. 1(1-0) Interdepartmental with Agricultural Engineering Technology.
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.
- 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.
- 850. Dimensional Analysis and Similitude Modelling**
Spring of odd-numbered years. 3(2-2) Approval of department.
Use of dimensional analysis to develop general prediction equations of physical systems. Model theory, distorted models, and analogies. Application to the problems in agricultural engineering.

Descriptions — Agricultural Engineering of Courses

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.

890. Advanced 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.

New developments in agricultural engineering. Topics will be chosen from advanced finite element methods, water management, post-harvest processing, animal housing, automation and robotics, scale-up methods in food engineering machinery systems.

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

Winter. 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.

804. Agricultural Mechanization in Developing Countries

Fall of odd-numbered years. 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.

806. Analysis of Agricultural Systems

Winter. 3(3-0) AET 440.

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

807. Human Factors Engineering

Fall of even-numbered years. 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 people and machine.

808. Environmental Measurements

Spring of odd-numbered years. 4(3-3) MTH 109 or MTH 111, STT 422; or approval of department. Interdepartmental with the Department of Geography.

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.

820. Research Methods

Fall. 1(1-0) Approval of department. Interdepartmental with Building Construction Management.

Procedures for initiating, developing, carrying out and completing research projects.

822. Seminar

Spring. 1(1-0) Approval of department.

880. Special Problems

Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 6 credits. Approval of department.

Individual study or research on selected topics.

890. Advanced Topics in Agricultural Engineering Technology

Fall, Winter, Spring. 3(3-0) May reenroll for a maximum of 12 credits if different topics are taken. Approval of department.

New developments in agricultural engineering technology.

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 Technology and Systems Management

ATM

202. Agricultural Metalworking

(AET 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.

231. Land and Soil Surveying Technology

Fall. 2(1-2) MTH 108 or MTH 111.

Concepts of land and soil surveying; distance and area measurements, differential leveling, land surveys and mapping, soil surveys, physical properties of soils, building site evaluation.

240. Principles of Agricultural Tractors and Machinery

Fall. 2(1-2)

Principles, operating characteristics, and applications of agricultural tractors and machinery for tillage, planting, cultivating and harvesting field crops.

245. Agricultural and Automotive Engines

(AET 243, AET 244, AET 245.) Fall. 3(2-2)

Construction, maintenance and operating principles of gasoline and diesel engines used in agricultural and automotive applications. Ignitions, fuels, lubricants, emission controls, and performance. Laboratory experiences in engine maintenance procedures.

258. Technical Skills

(AET 258.) 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.

265. Fluid Power Systems

(AET 265.) Winter. 3(2-2)

Fluid power in mobile equipment. Operation and characteristics of system components and circuits. Laboratory includes component disassembly, system diagnosis and testing, and patch-board work.

311. Management Principles for Physical Systems

(AET 311.) Fall. 3(3-0) CPS 115, MTH 108 or MTH 111.

Quantitative methods applicable to management of agricultural and construction systems; linear programming, PERT, queueing, decision theory and simulation.

312. Structural Design

Winter. 4(5-0) PHY 237 or approval of department; BCM 215 recommended. Interdepartmental with and administered by Building Construction Management.

Concepts of structural mechanics, material strengths and section properties are developed and applied to design using wood, steel and concrete.

329. Unit Operation and Food Processing I

(AET 329.) 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.

340. Technology of Agricultural Tractors and Machinery

(AET 323, AET 340.) Spring. 3(3-0) MTH 108 or MTH 111; CPS 115, ATM 240; PHY 237 recommended.

Technology, analysis and performance of agricultural tractors and machinery for tillage, planting, cultivating, and harvesting field crops.

415. Occupational and Personal Safety

(AET 415.) Winter. 3(3-0) Juniors.

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

421. Electrical Equipment Technology

(AET 421.) Spring. 4(3-2) PHY 238 or approval of department.

Application of electrical energy; selection, operation and control of electrical equipment. Planning of electrical systems.

426. Production and Storage Systems

(AET 416, AET 426.) Spring. 4(4-0) AET 311, BCM 312.

Layout of buildings and material handling systems; interior environment and its control; requirements for livestock production and crop storage.

431. Management of Irrigation and Drainage Systems

(AET 431.) Spring. 4(3-2) ATM 231, CSS 210 or approval of department.

Surveying, planning, construction and cost estimation of irrigation, drainage, and water control systems.

436. Microclimatology

(AET 436.) Winter of even-numbered years. 3(3-0) MTH 109 or MTH 111. Interdepartmental with the Department of Geography.

Physical environment in the lower few hundred meters of the atmosphere and within the biosphere.

440. Agricultural Tractor and Machinery Systems
(AET 443, AET 440.) Fall. 3(3-0) ATM 340, ATM 311 or approval of department.

Management, analysis and economics of agricultural tractor and machinery systems considering weather conditions, farming types and techniques, crop rotation, labor and energy. Application of computer programs.

480. Special Problems
(AET 480.) 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.

490. Special Topics in Agricultural Technology and Systems Management

(AET 490.) Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 8 credits if different topics are taken. Approval of department.

Topics such as computer access to technology; technology in natural resource management; entrepreneurship; technology in agricultural management.

Building Construction Management **BCM**

200. American Housing and Building Industry
(B C 200.) Fall, Spring. 3(3-0)

Residential and light commercial construction industry in America. Impacts of government, finance, zoning ordinances, codes, aesthetics, construction technology, demographics, energy and society.

201. Building Construction Mechanics
(A E 402, AET 201.) Fall. 3(2-3)
Approval of department.

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

215. Architectural Drafting I
(B C 215.) Fall, Summer. 4(2-4)

Residential design including site plans, floor plans, foundation plans, elevations, sections and details.

216. Architectural Drafting II
(B C 216.) Winter. 4(2-4) BCM 215.

Light commercial design including site plans, floor plans, foundation plans, elevations, sections and details, barrier free accessibility.

239. Housing Conservation
(B C 239.) Fall. 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.

301. Energy Conservation Systems for Buildings
(B C 301.) Winter. 3(3-0) BCM 215, MTH 109 or MTH 111 or approval of department.

Solar energy, earth sheltered and energy conservation systems for buildings will be analyzed for operation, optimum size, construction, performance, climate, cost effectiveness and human comfort for northern climates.

312. Structural Design
(B C 312.) Winter. 4(5-0) PHY 237 or approval of department; BCM 215 recommended. Interdepartmental with Agricultural Technology and Systems Management.

Concepts of structural mechanics, material strengths and section properties are developed and applied to design using wood, steel and concrete.

313. Construction Systems
(B C 413.) Spring. 4(3-2) BCM 200, BCM 215, CPS 115.

Primary construction systems employed in the residential and light commercial construction industry. Interrelationships between planning, processes, costs and management.

412. Utilities Design
(B C 412.) Fall. 4(4-0) PHY 238, BCM 215 or approval of department.

Design and planning for mechanical and electrical utilities in residential and light commercial construction.

415. Building Materials
(B C 415.) Spring. 4(4-0) BCM 312 or approval of department.

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

416. Building Costs
(B C 416.) Winter. 4(2-4) BCM 312 or concurrently.

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

417. Construction Management Finance
(B C 417.) Winter. 4(4-0)

Financing methods for the construction, rehabilitation, and purchase of real estate.

418. Special Problems
(B C 418.) Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 11 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.

419. Senior Seminar
(B C 419.) Fall. 1(1-0) Senior majors.

Professional practices, business ethics, market trends, and structure of the construction industry.

420. Construction Management
(B C 420.) Spring. 4(4-0) Senior majors.

Systems management techniques for building organizations; development, operations, planning, scheduling and control, and administrative procedures.

820. Research Methods
(B C 820.) Fall. 1(1-0) Approval of department. Interdepartmental with and administered by Agricultural Engineering Technology.

Procedures for initiating, developing, carrying out and completing research projects.

880. Special Problems
(B C 880.) Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 6 credits. Approval of department.

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

890. Advanced 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.

Topics will be selected from: computer methods in construction management, advanced construction management, optimization techniques, solar energy buildings, advanced estimating, numerical structural analysis, new construction techniques and materials.

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

Food Engineering **F E**

433. Dehydration of Biological Materials
Spring. 3(3-0) CHE 341.

Principles and applications of the dehydration of biological products; including fixed bed, fluidized bed, tray, rotary, drum, spray, pneumatic, microwave, and solar drying of food and feed products.

473. Unit Operations in Food Engineering
Fall. 3(3-0) CHE 341.

Transport phenomena. Unit operations in food process engineering. Physicochemical changes in food materials during unit processes.

475. Rheology of Non-Newtonian Fluids
Fall. 3(3-0) F E 473.

Rheology and non-Newtonian fluid dynamics. Pipeline design. Mixing and agitation. Freezing. Mechanical separation: filtration, sedimentation, centrifugation, extension.

477. Thermal Process Engineering
Winter. 3(2-2) F E 475.

Thermal processing of biological materials. Thermal death kinetics, pasteurization and sterilization. Thermobacteriology. Food reaction kinetics. Food reactor design. Thermal process evaluation. Aseptic processing.

487. Food Engineering Design
Winter. 3(3-0) F E 477 or concurrently; A E 486.

Design and scale-up of food processes and equipment. Process and product specifications. Engineering feasibility studies. Prediction of process performance, quality, efficiency, and manufacturing cost.

**AGRICULTURAL
ENGINEERING
TECHNOLOGY**

See Agricultural Engineering.

**AGRICULTURAL
TECHNOLOGY AND
SYSTEMS MANAGEMENT**

See Agricultural Engineering.