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.

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 policies are 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 390 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.

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. 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.

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 analysis include differential earnings and occupations of men and women, employment discrimination and labor legislation.

Agricultural Engineering

College of Agriculture and Natural Resources

152. Introduction to Agricultural Engineering
Fall, Spring, 11-0 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 & 253.
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.

355. Electric Power and Control
Winter, 4(3-2) PHY 295. 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 353, 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(4-0) MMP 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, 3(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) MMP 211, MMP 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 machinery, 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.

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, brakes, 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 problems 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 496. Activities include information expansion, developing alternatives, evaluation, selection, and finalizing project.

808. Finite Element Method
Fall, Winter, Spring, Summer. 1 to 5 credits. May reenroll for a maximum of 5 credits. Approval of department. 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, forage and forage plants and other agricultural products under constant and dynamic loading. Related to design parameters for production, handling and processing machinery.
201. Technical Agricultural Mechanics Skills
(AET 452.) 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
Winter. 3(2-3)
Principles, skills and safety for welding, soldering, brazing, cutting, bench work, metalurgy, fastening and ship tools. Maintenance metalworking for farm and agribusiness shops will be emphasized.

245. Agricultural and Automotive Engines
(AET 283, AET 244) Spring, 3(2-2)
Construction, maintenance and operation principles of gasoline and diesel engines used in agricultural and automotive applications. Ignition, fuels, lubricants, emission controls, and performance. Laboratory experiences in engine maintenance procedures.

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.

265. Hydraulic Power Systems
Fall. 4(3-2)
Hydraulic power in mobile equipment. Operation and characteristics of system components and circuits. Labortory includes component disassembly, system diagnosis and testing, and patch-board work.

311. Management Principles for Physical Systems
Fall. 3(3-0) CPS 115 or CPS 120; MTH 111 or MTH 108.
Quantitative methods applicable to management of agricultural and construction systems; linear programming, FERT, queuing, decision theory and simulation.

312. Structural Design
Winter. 4(5-0) PHY 237, BCM 215 or approval of department. Interdepartmental with Building Construction Management.
Concepts of structural mechanics, material strengths and section properties are developed and applied to design using wood, steel and concrete.

324. Processing Systems for Biological Products
Spring. 4(4-0) MTH 108 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
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. Principles of Agricultural Tractors and Machinery
(AET 222.) Fall. 4(3-2) MTH 108 or MTH 111; CPS 115 or CPS 120.
Principles, analysis, performance, and operating characteristics of agricultural tractors and machinery for tillage, planting, cultivating, and harvesting field crops.

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

401. Teaching Agricultural Mechanics
(A ET 402.) Spring. 3(2-3) Approval of department.
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.

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.

426. Production and Storage Systems
(AET 416.) Fall. 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. 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.

432. Microclimatology
Winter. 3(3-0) MTH 108, GEO 351 recommended. Interdepartmental with the Department of Geography.
Physical environment in the lower few hundred meters of the atmosphere and within the biosphere.
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(2-0) 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. 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.

Agriculture and Natural Resources — Descriptions of Courses

Building Construction Management

200. American Housing and Building Industry
(B C 200.) Fall, Winter, Spring, Summer. 3(2-0) Residential and light commercial construction industry in America. Impacts of government, finance, zoning ordinances, codes, aesthetics, construction technology, demographics, energy and society.

215. Architectural Drafting I
(B C 215.) Fall, Winter, Spring. 4(2-4) Residential design including site plans, floor plans, foundation plans, elevations, sections and details.

216. Architectural Drafting II
(B C 216.) Winter, Summer. 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
(AET 239., B C 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.

301. Energy Conservation Systems for Buildings
(B C 301.) Winter. 3(3-0) BCM 215, MTH 168 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, BCM 215 or approval of department. Interdepartmental with Agricultural Engineering Technology. Concepts of structural mechanics, material strengths and sections; 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 116. 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, Winter, Spring. 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(3-4) 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. 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.

429. Research Methods
(B C 429.) Fall. 1(1-0) Approval of department. Procedures for initiating, developing, carrying out and completing research projects.

580. 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.

899. 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.

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

Agricultural Engineering Technology
See Agricultural Engineering.

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220. Plants and Their Environment
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
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 8 credits if different topics are taken. Approval of department.

341. Energy in the Food System

350. Leadership Development for Agriculture and Natural Resources
Winter, Spring. 3(3-0) Glenn at W. K. Kellogg Biological Station. Fall, Spring. 2 credits. May reenroll for a maximum of 8 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.