BIOSYSTEMS ENGINEERING BE

Department of Biosystems and Agricultural Engineering
College of Agriculture and Natural Resources

101 Introduction to Biosystems Engineering
Fall. 1(0-2) P: (MTH 116 or concurrently) or (MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently) SA: BE 130
Introduction to the profession of biosystems engineering. Case studies of engineering design problems with a biological component. Exploration of career opportunities and ethical framework for the profession.

230 Engineering Analysis of Biological Systems
Spring. 3(3-0) P: (MTH 132 or MTH 152H or LB 118) and ((BS 110 or concurrently) or (BS 148H or concurrently) or (LB 144 or concurrently)) and (EGR 102 or concurrently)
Biosystems modeling of growth and dynamic interactions. Conservation of mass, and sustainability. Steady-state and stability analysis. Ecological concepts. Life-cycle analysis. Design for environment.

332 Engineering Properties of Biological Materials
Fall. 3(3-0) P: (BE 101 or concurrently) and (BS 111 or BS 149H or LB 145) and CE 221 R: Open to juniors or seniors in the Department of Biosystems and Agricultural Engineering. C: BE 333 concurrently.
Physical, thermal, and electromagnetic properties of biological materials necessary for the design and analysis of processes and equipment in biosystems.

333 Biosystems Engineering Laboratory
Fall. 1(0-3) P: (BE 101 or concurrently) and (BS 111 or BS 149H or LB 145) R: Open to juniors or seniors in the Department of Biosystems and Agricultural Engineering.
Measurement of physical, chemical, and biological parameters. Properties that characterize engineered biosystems. Data collection and analysis. Experiment design.

350 Heat and Mass Transfer in Biosystems
Spring. 3(3-0) P: (BE 101 or concurrently) and (MTH 235 or MTH 255H or LB 220) and ((CE 321 or concurrently) or (CHE 311 or concurrently) or (ME 332 or concurrently)) and ((CEM 143 or concurrently) or (CEM 251 or concurrently)) R: Open to students in the College of Engineering. Not open to students with credit in ME 410.
Steady state and transient heat conduction. Radiation and convection heat transfer. Heat exchangers. Mass transfer application problems in biosystems engineering.

351 Thermodynamics for Biological Engineering
Fall. 3(3-0) P: (BE 101 or concurrently) and (MTH 235 or MTH 255H or LB 220) and (BS 111 or BS 149H or LB 145) R: Open to juniors or seniors in the College of Engineering. Not open to students with credit in CHE 321 or ME 201.
Thermodynamics of biological systems. First and second laws of thermodynamics. Power and refrigeration cycles. Water relations and psychrometry. Chemical and phase equilibria.

360 Microbial Systems Engineering
Spring. 3(3-0) P: (BE 230 or concurrently) and (BS 111 or BS 149H or LB 145) and MTH 235 R: Open to juniors or seniors in the College of Engineering.
Application of engineering and biological principles to the analysis of microbial systems. Kinetic analyses and modeling of microbial growth, survival, and inactivation for engineering applications.

385 Engineering Design and Optimization for Biological Systems
Spring. 3(2-2) P: (BE 101 and (BE 230 or concurrently)) and (MTH 235 or MTH 255H or LB 220) and (BS 111 or BS 149H or LB 145) R: Open to juniors or seniors in the College of Engineering. SA: BE 431
Design and optimization techniques applied to engineering problems with biological constraints. Project management. Engineering economics. Linear programming.

402 Agricultural Climatology
Fall of even years. 3(3-0) Interdepartmental with Geography. Administered by Geography. P: MTH 104 or MTH 110 or MTH 116 R: Not open to freshmen or sophomores.
Relationships between climate and agriculture in resource assessment, water budget analysis, meteorological hazards, pests, crop-yield modeling, and impacts of global climate change.

418 Comprehensive Nutrient Management Planning
Fall. 3(2-2) Interdepartmental with Animal Science. Administered by Animal Science. P: (CEM 143 or CEM 251) and (BS 111 or LB 145) RB: CSS 210
Comprehensive nutrient management plans (CNMP) for animal feeding operations. Trends in animal production, environmental issues, and diet formulation and their impact on manure production. Development of CNMP for a specific animal feeding operation.

419 Applications of Geographic Information Systems to Natural Resources Management
Spring. 4(2-4) Interdepartmental with Community, Agriculture, Recreation and Resource Studies and Forestry and Fisheries and Wildlife and Geography. Administered by Fisheries and Wildlife. P: GEO 221
Application of geographic information systems, remote sensing, and global positioning systems to integrated planning and management for fish, wildlife, and related resources.

429 Fundamentals of Food Engineering
Spring. 3(3-0) Interdepartmental with Food Science. Administered by Biosystems Engineering. P: FSC 325 and MTH 126 and PHY 231 RB: FSC 211 R: Not open to students in the College of Engineering. SA: BE 329
Definition and measurement of food properties, thermodynamics, fluid mechanics, heat transfer, and mass transfer.

443 Restoration Ecology
Spring. 3(2-2) Interdepartmental with Fisheries and Wildlife and Zoology. Administered by Fisheries and Wildlife. RB: (CSS 210 or BE 230) and (FOR 404 or FW 364 or ZOL 355)
Principles of ecological restoration of disturbed or damaged ecosystems. Design, implementation, and presentation of restoration plans.

445 Biosensors for Medical Diagnostics
Spring. 3(3-0) P: (BS 111 or LB 145) and (CEM 141 or CEM 151) and (ECE 302 or ECE 345) RB: Biology, chemistry, and electronics R: Open to juniors or seniors or graduate students in the College of Engineering. Not open to students with credit in BE 845.
Biosensors, their components, properties, and associated electronics for applications in medical diagnostics.

452 Watershed Concepts
Fall, Spring, Summer. 3(3-0) Interdepartmental with Crop and Soil Sciences and Environmental Studies and Agriscience and Forestry and Fisheries and Wildlife. Administered by Environmental Studies and Agriscience. P: ESA 324 and ZOL 355 RB: organic chemistry SA: RD 452
Watershed hydrology and management. The hydrologic cycle, water quality, aquatic ecosystems, and social systems. Laws and institutions for managing water resources.

456 Electric Power and Control
Spring. 3(2-2) P: ECE 201 or ECE 345 SA: AE 356
Alternating current circuits, power distribution, electrical machines, protection, and programmable motor controllers. Design project related to food and agricultural industries.

460 Natural Resource Economics
Spring. 3(3-0) Interdepartmental with Environmental Economics and Policy and Environmental Studies and Applications and Park, Recreation and Tourism Resources. Administered by Environmental Studies and Applications. P: EC 201 and (ESA 302 or EEP 255) SA: RD 460
Economic framework for analyzing natural resource management decisions. Spatial and inter-temporal allocation of renewable and nonrenewable resources. Special emphasis on institutions, externalities, and public interests in resource management.

467 BioEnergy Feedstock Production
Fall. 3(3-0) Interdepartmental with Crop and Soil Sciences and Forestry. Administered by Crop and Soil Sciences. P: MTH 103 or MTH 116 RB: CSS 101 and CSS 210
Agronomic, economic, technological, and environmental principles involved in bioenergy feedstock production. Cultivation, harvest, transportation, and storage of agricultural and forest biomass.

468 Biomass Conversion Engineering
Fall. 3(3-0) Interdepartmental with Chemical Engineering. Administered by Chemical Engineering. P: (BE 351 or CHE 321) and (BE 360 or CHE 431)
Physicochemical and biological pretreatment. Biomass conversion to alcohols, biodiesel, bio-oil, syngas, and other value-added products using advanced biological, chemical, and thermochemical treatments.

469 Sustainable Bioenergy Systems
Spring. 3(3-0) Interdepartmental with Chemical Engineering. Administered by Biosystems Engineering. P: BE 230 or CHE 201 RB: CSS 467 and CHE 468 R: Open to juniors or seniors in the College of Engineering.
Biorefinery analysis and system design. Life cycle assessment to evaluate sustainability of bioenergy systems. Current policy regulating the bioeconomy and system economics. Product commercialization.

475 International Studies in Biosystems Engineering
Fall, Spring, Summer. 1 to 6 credits. Fall: Abroad. Spring: Abroad. Summer: Abroad. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department; application required.
Study abroad emphasizing biosystems and agricultural engineering issues affecting agriculture and natural resources in world, national, and local communities.

477 Food Engineering: Fluids
Fall. 3(2-2) Interdepartmental with Food Science. Administered by Biosystems Engineering. P: BE 350 and BE 351 SA: FE 465
Unit operations, process engineering, equipment, and industrial practices of the food industry. Manufactured dairy products: thermal processing, pipeline design, heat exchange, evaporation, dehydration, aseptic processing, membrane separation, cleaning, and sanitation.

478 Food Engineering: Solids
Spring. 3(2-2) P: BE 350 and BE 351 and BE 360
Analysis and design of unit operations and complete systems for handling, processing, and manufacturing bulk, granular, and solid food products. Material variability and microbial, chemical, and physical hazards.

481 Land and Water Conservation Engineering
Fall. 3(2-2) P: (CE 321 or CHE 311 or ME 332) and (BE 351 or concurrently) SA: AE 481
Hydrology of small watersheds. Flood routing. Quantifying runoff, infiltration, evapotranspiration. Drainage design. Global Positioning Systems. Geographic Information Systems and applications in engineering projects. Irrigation efficiency.

482 Non-point Source Pollution Control
Spring. 3(2-2) P: (BE 481 or CE 421) and BE 350 and BE 360
Identification, estimation, and control of non-point source pollution from agricultural and urban sources. Geographic Information Systems (GIS) based computer models of watersheds. Engineering design of practices and structures to control non-point source pollution. Development of watershed management plans.

485 Biosystems Design Techniques
Fall. 3(2-2) P: BE 332 and BE 333 and BE 350 and BE 351 and BE 360 and BE 385 and (STT 351 or concurrently) R: Open to juniors or seniors in the Biosystems Engineering major. SA: BE 486
Engineering design process. Problem identification, analysis, design, modeling, materials, cost estimation, and final specifications. Safety, environmental, and ethical considerations.

487 Biosystems Design Project (W)
Spring. 3(0-6) P: (BE 485) and completion of Tier I Writing requirement R: Open to seniors in Biosystems Engineering major. SA: AE 488
Individual or team design project selected in BE 485. Information expansion, development of alternatives, and evaluation, selection, and completion of a design project.

490 Independent Study
Fall, Spring, Summer. 1 to 5 credits. A student may earn a maximum of 5 credits in all enrollments for this course. P: (BE 230 or BE 350) R: Approval of department; application required. SA: AE 490
Supervised individual student research and study in biosystems engineering.

491 Special Topics in Biosystems Engineering
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. P: (BE 230 or BE 331 or BE 350) R: Approval of department. SA: AE 491
Special topics in biosystems engineering.

815 Instrumentation for Biosystems Engineering
Spring. 3(3-0) SA: AE 815
Theory and techniques of measuring temperature, pressure, flow, humidity, and moisture in biological materials.

820 Research Methods in Biosystems Engineering
Fall. 1(1-0) R: Open only to graduate students in the College of Agriculture and Natural Resources or College of Engineering. SA: AE 820
Procedures and methods for designing and executing research projects.

825 Properties of Biological Materials
Fall. 3(3-0)
Determination, analysis, and modeling of engineering properties of materials encountered in biological engineering.

835 Engineering Analysis and Optimization of Biological Systems
Fall. 3(3-0) RB: Undergraduate degree in an engineering discipline, and one year of biological science.
Application of quantitative modeling methods to the description, analysis, design, and operation of biological systems. Dimensional analysis. Theory of models. Network design. Life-cycle assessment. Multi-criteria optimization.

845 Biosensor Principles and Applications
Spring. 3(3-0) RB: Knowledge of biology, chemistry, and electronics.
Nanotechnology-based biosensors, their components, desirable properties, and associated electronics. Applications related to healthcare, biodefense, food and water safety, agriculture, bio-production, and environment. Multidisciplinary interactions necessary for biosensor development.

852 Systems Modeling and Simulation
Fall of even years. 3(3-0) Interdepartmental with Forestry and Fisheries and Wildlife and Resource Development. Administered by Fisheries and Wildlife. RB: STT 422 or STT 442 or STT 464 or GEO 463
General systems theory and concepts. Modeling and simulation methods. Applications of systems approach and techniques to natural resource management, and to ecological and agricultural research.

853 Applied Systems Modeling and Simulation for Natural Resource Management
Spring of odd years. 3(2-2) Interdepartmental with Forestry and Fisheries and Wildlife and Resource Development and Zoology. Administered by Fisheries and Wildlife. RB: (FW 820 or BE 486 or ZOL 851) or or approval of department. R: Open only to seniors and graduate students
Mathematical models for evaluating resource management strategies. Stochastic and deterministic simulation for optimization. System control structures. Team modelling approach.

870 Engineering Methods for Food Safety
Fall. 3(3-0) RB: Undergraduate degree in engineering and/or a functional knowledge of calculus, food microbiology, and basic principles of food engineering.
Engineering methods for ensuring the safety of processed food products. Emphasis on meeting government regulations for thermal processing and safety of commercially processed products. Predictive models for microbial growth, survival, and inactivation. Applying experimental data and mathematical models for process validation. Statistical methods for process variability, as related to food safety.

890 Special Problems
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department; application required. SA: AE 890
Individual study in biosystems engineering.

891 Advanced Topics in Biosystems Engineering
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to seniors and graduate students. SA: AE 891
Biosystems engineering topics not covered in regular courses.

892 Biosystems Engineering Seminar
Spring. 1(1-0) R: Open only to graduate students in the College of Agriculture and Natural Resources or College of Engineering. SA: AE 892
Current topics in biosystems engineering.

899 Master's Thesis Research
Fall, Spring, Summer. 1 to 10 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to master's students in the Biosystems Engineering major. SA: AE 899
Master's thesis research.

999 Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to doctoral students in the Biosystems Engineering major. SA: AE 999
Doctoral dissertation research.