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 162 or concurrently) or (BS 182H 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 161 or BS 181H or LB 145) and CE 221 R: Open to juniors or seniors in the Department of Biosystems and Agricultural Engineering.
Physical and thermal properties of biological materials necessary for the design and analysis of processes and equipment in biosystems.

334 Biosystems Engineering Laboratory Practice
Fall. 3(2-2) P: (BE 101 or concurrently) and (BS 171 or BS 172) and PHY 184 R: Open to juniors or seniors in the Department of Biosystems and Agricultural Engineering. C: BE 332 concurrently.
Sensors and instrumentation for measuring and analyzing properties of biological materials and systems.

350 Heat and Mass Transfer in Biosystems
Spring. 3(3-0) P: (BE 101 or concurrently) and (MTH 235 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) or (CEM 351 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 161 or BS 181H or LB 145) R: Open to juniors or seniors in the College of Engineering.
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 (MTH 235 or concurrently) 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) 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 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 Animal Agriculture and the Environment
Fall. 3(2-2) Interdepartmental with Animal Science. Administered by Animal Science. P: (BS 161 or LB 145 or BS 181H) and (CEM 143 or CEM 251) 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 Forestry and Fisheries and Wildlife and Geography. Administered by Fisheries and Wildlife. RB: 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 124 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 Plant Biology and Zoology. Administered by Fisheries and Wildlife. P: FOR 404 or PLB 441 or ZOL 355 RB: CSS 210 or BE 230
Principles of ecological restoration of disturbed or damaged ecosystems. Design, implementation, and presentation of restoration plans. Field trips required.

444 Biosensors for Medical Diagnostics
Spring. 3(3-0) Interdepartmental with Biomedical Engineering. Administered by Biosystems Engineering. P: (BS 161 or BS 181H or LB 145) and (CEM 141 or CEM 151) and (ECE 302 or ECE 345 or BE 334 or CEM 333) R: Open to juniors or seniors or graduate students in the College of Engineering. SA: BE 445
Biosensors, their components, properties, and associated electronics for applications in medical diagnostics.

449 Human Health Risk Analysis for Engineering Controls
Fall. 3(2-2) P: (BE 385 and BE 360 and BE 332) or (CE 371 and CE 372 and ENE 487) R: Open to juniors or seniors in the College of Engineering.
Characterize human health risk from microbial stressors. Develop and evaluate engineering controls for risk management.

452 Watershed Concepts
Fall, Spring, Summer. 3(3-0) Interdepartmental with Crop and Soil Sciences and Community Sustainability and Forestry and Fisheries and Wildlife. Administered by Community Sustainability. P: CSUS 354 RB: Organic chemistry SA: RD 452, ESA 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: BE 334 SA: AE 356
Alternating current circuits, power distribution, electrical machines, protection, and programmable motor controllers. Design project related to food and agricultural industries.

457 Bioenergy Feedstock Systems Analysis
Fall. 3(2-2) Interdepartmental with Forestry. Administered by Biosystems Engineering. P: FOR 404 or approval of department R: Open to juniors or seniors.
Equipment used for harvesting, pre-processing, and transporting woody biomass from natural forests and energy wood plantations; cost control and system optimization in woody biomass supply chain; environmental impact of woody biomass recovery.

461 Seminar in Plant, Animal and Microbial Biotechnology
Spring. 1(1-0) Interdepartmental with Animal Science and Crop and Soil Sciences and Horticulture. Administered by Horticulture. P: (ANS 425 or concurrently) or (BE 360 or concurrently) or (CSS 451 or concurrently) or (MMG 445 or concurrently)
Current applications of plant, animal and microbial biotechnology in agriculture and related industries. Technologies under development and factors associated with moving from laboratory to product development. Field trips required.

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 or MTH 124 or MTH 132 or LB 118 or MTH 152H or MTH 133 or MTH 153H or LB 119 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 and BE 360 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 Water Resources Systems Analysis and Modeling
Fall. 3(2-2) P: CE 321 or CHE 311 or ME 332 R: Open to juniors or seniors in the College of Engineering. SA: AE 481
Hydrology of natural systems. Quantifying runoff, infiltration, and evapotranspiration. Geospatial data collection at watershed scale. Geographical information system application in hydrology and ecosystems engineering. Watershed modeling and applications in engineering design and decision-making.

482 Diffuse-Source Pollution Engineering
Spring. 3(2-2) P: (BE 350 or ENE 483) and (BE 360 or ENE 487) R: Open to juniors or seniors in the College of Engineering.
Identification, estimation, and control of diffuse source pollution from agricultural and urban sources. Analysis of diffuse source pollutants in biological systems. Engineering design of practices and structures to prevent, mitigate, and treat diffuse source pollution, including low impact development (LID) strategies.

485 Biosystems Design Techniques
Fall. 3(2-2) P: BE 332 and BE 334 and BE 350 and BE 351 and BE 360 and BE 385 or approval of department 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. R: Approval of department; application required.
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. R: Approval of department.
Special topics in biosystems engineering.

815 Experimentation and Instrumentation in Biosystems Engineering
Spring. 3(2-2) R: Open to graduate students in the College of Agriculture and Natural Resources or in the College of Engineering. SA: AE 815
Establish generalized experimental study planning, measurement, data collection and execution skills, which are applicable to individual topics/projects/areas in biological systems.

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.

835 Modeling Methods in Biosystems Engineering
Fall. 3(2-2) RB: Undergraduate degree in an engineering discipline, and one year of biological science. R: Open to graduate students in the College of Agriculture and Natural Resources or in the College of Engineering.
Establish generalized model planning and execution skills, which is applicable to individual topics/projects/areas in biological systems.

844 Biosensor Principles and Applications
Spring. 3(3-0) Interdepartmental with Biomedical Engineering. Administered by Biosystems Engineering. RB: Knowledge of biology, chemistry, and electronics. SA: BE 845
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.

849 Quantitative Human Health Risk Modeling and Analysis for Microbial Stressors
Fall of even years. 3(2-2) P: STT 421 or STT 464 or (STT 814 or concurrently) or approval of department RB: probability theory, mathematical modeling covered in the engineering and quantitative sciences. Background in toxicology, microbiology, food safety, and/or public health.
Characterization of human health risk from exposures to environmental stressors. Development of empirical and statistical models for health effects and exposure analysis. Probabilistic risk characterization, uncertainty and sensitivity analysis. Problem-based critical evaluation of risk-based environmental decisions.

869 Life Cycle Assessment for Bioenergy and Bioproduct Systems
Spring. 3(3-0) Interdepartmental with Chemical Engineering. Administered by Biosystems Engineering. R: Open to graduate students in the College of Engineering or in the Department of Biosystems and Agricultural Engineering or approval of department. Not open to students with credit in BE 469.
Life cycle assessment to evaluate the environmental impacts of biological and chemical conversion processes. Biomass supply chain economics and technoeconomics for biomass conversion. Current policy considerations impacting the adoption of bioenergy and bioproduct systems.

881 Ecohydrology
Fall of odd years. 3(3-0) RB: BE 481 or ENE 421 or FW 454
Identify and quantify the critical linkages between ecological processes and the hydrological cycle.

882 Advanced Topics in Ecological Engineering
Fall. 3(3-0) RB: Undergraduate course or equivalent experience on biological and chemical process design and hydraulics.
Rural and suburban water quality challenges. Science and design of rural and suburban water treatment and resource recovery systems.

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 36 credits in all enrollments for this course. R: Open to doctoral students in the Biosystems Engineering Major. SA: AE 999
Doctoral dissertation research.