

# BIOSYSTEMS ENGINEERING

BE

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

- 130 Engineering Design Fundamentals for Biological Systems**  
Fall. 2(1-2) P:M: (MTH 132 or concurrently) or (MTH 114 or concurrently) or (MTH 116 or concurrently) or (LBS 117 or concurrently) or (LBS 118 or concurrently) or MTH 152H

Professional and fundamental methods of biosystems engineering. Basic engineering methods. Analysis and design. Interdisciplinary design.

- 230 Engineering Analysis of Biological Systems**  
Spring. 3(3-0) P:M: (MTH 132 or MTH 152H or LBS 118) and (BS 110 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.

- 329 Fundamentals of Food Engineering**  
Spring. 3(3-0) Interdepartmental with Food Science. Administered by Biosystems Engineering. P:M: FSC 325 and (MTH 126 or LBS 118) and (PHY 231 or LBS 271) RB: FSC 211 SA: FE 329

Unit operations in food industry: fluid mechanics, heat transfer, rate processes, refrigeration, freezing, and dehydration. Thermal process calculations.

- 332 Engineering Properties of Biological Materials**  
Fall. 3(3-0) P:M: (BS 111 or PLB 105 or MMG 201) and ME 221 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:M: BS 110 or BS 111 or PLB 105 or ENT 205 or MMG 201 or MMG 301 or PSL 250 or ZOL141 R: Open only to students in the Biosystems Engineering major.

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:M: (MTH 235 or MTH 255H or LBS 220) and CSE 131 and ((CE 321 or concurrently) or (CHE 311 or concurrently) or (ME 332 or concurrently) or (CE 321 or concurrently) or (CHE 311 or concurrently) or (ME 332 or concurrently)) and (CEM 143 or concurrently) R: Open only 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 Environmental Thermodynamics**  
Fall. 3(3-0) P:M: (MTH 235 or MTH 255H or MTH 340 or LBS 220) and (BS 111 or MMG 201 or PLB 105) Not open to students with credit in CHE 321 or ME 201.

First and Second Laws of Thermodynamics with applications in food, biosystems, and environmental engineering. Refrigeration cycles. Entropy. Thermodynamic aspects of fluid flow. Psychrometrics.

- 402 Agricultural Climatology**  
Fall of even years. 3(3-0) Interdepartmental with Geography. Administered by Geography. P:M: 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:M: 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. RB: GEO 221 Not open to students with credit in GEO 425.

Application of geographic information systems, remote sensing, and global positioning systems to integrated planning and management for fish, wildlife, and related resources.

- 431 Bio-resource Optimization**  
Fall. 3(2-2) P:M: BE 230 and (MTH 235 or MTH 255H or LBS 220) Not open to students with credit in BE 831.

Optimal engineering solutions to problems with conflicting objectives and biological constraints. Linear and goal programming, problem formulation, project management, risk and uncertainty.

- 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.

- 456 Electric Power and Control**  
Spring. 3(2-2) P:M: 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.

- 477 Food Engineering: Fluids**  
Fall. 3(2-2) Interdepartmental with Food Science. Administered by Biosystems Engineering. P:M: 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:M: BE 350 and BE 351  
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:M: CSE 131 and (CE 321 or CHE 311) 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:M: (BE 481 or CE 421) and BE 350

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:M: BE 130 and BE 332 and BE 333 and BE 350 and BE 351 and (BE 431 or concurrently) 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:M: (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:M: (BE 230 or BE 350) R: Approval of department; application required. SA: AE 490

Supervised individual student research and study in biosystems engineering.

## Biosystems Engineering—BE

- 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:M: (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.
- 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.