

# BIOSYSTEMS & AG ENGINEERING (BAE)

## BAE 1012 Introduction to Biosystems Engineering

**Prerequisites:** Engineering major.

**Description:** Introduction to the Biosystems Engineering discipline; use of computers in solving engineering problems; and the application of computer software in engineering analysis and reporting.

**Credit hours:** 2

**Contact hours:** Lecture: 1 Lab: 2

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

## BAE 1022 Experimental Methods in Biosystems Engineering

**Prerequisites:** BAE 1012 or consent of instructor.

**Description:** An introduction to the basics of instrumentation, measurement techniques, and data analysis, with an emphasis on written communication skills. Lecture and laboratory exercises that address measurement principles, including accuracy, precision and error analysis.

**Credit hours:** 2

**Contact hours:** Lecture: 1 Lab: 2

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

## BAE 2013 Modeling in Biosystems Engineering

**Prerequisites:** MATH 2144; BIOL 1114 or BOT 1404.

**Description:** Introduction and modeling of various applications in biosystems and agricultural engineering. Case studies that emphasize the interface between engineering and biology in areas such as plant systems, industrial biological processes, sensor and control systems development, intelligent machine design, environmental remediation, water treatment systems and food processing. Use of a fourth generation programming language for solving engineering problems. Course previously offered as BAE 2012 and BAE 2022.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

## BAE 3013 Heat and Mass Transfer in Biological Systems

**Prerequisites:** ENSC 3233, MATH 2233.

**Description:** Mechanisms of heat and mass transfer, with specific applications in transport processes of biological systems. Introduction to steady state and transient heat conduction and convection, radiation, diffusion, simultaneous heat and mass transfer.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

## BAE 3023 Instruments and Controls

**Prerequisites:** ENSC 2613, MATH 2233.

**Description:** Design of control and instrumentation systems, including sensor and actuator principles, interface electronics, system identification, modeling, and performance specification. Applications in biological and agricultural systems. Design project required.

**Credit hours:** 3

**Contact hours:** Lecture: 2 Lab: 2

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

## BAE 3033 Advanced Biology and Material Science of Biomaterials

**Prerequisites:** BAE 1022, BIOL 1114 or BOT 1404, PHYS 2014, MATH 2144.

**Description:** Building on basic biology and engineering fundamentals to characterize properties of biological materials such as moisture content and water movement, rheology, electromagnetic response, thermal properties, conveyance requirements, psychometric interactions and heating/cooling response. Course previously offered as BAE 2022, BAE 2023, and BAE 3423.

**Credit hours:** 3

**Contact hours:** Lecture: 2 Lab: 2

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

## BAE 3113 Biological Applications in Engineering

**Prerequisites:** BAE 2012, BIOL 1114, ENSC 2213, 3233, MATH 2233 or concurrent enrollment.

**Description:** Introduction to engineering applications of biological processes. Technologies covered include fermentation systems, enzyme kinetics, wastewater treatment and bioremediation.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

## BAE 3213 Energy and Power in Biosystems Engineering

**Prerequisites:** BAE 1022, completion or concurrent enrollment in ENSC 2213, ENSC 2613, ENSC 3233.

**Description:** Analysis and design of energy generation, transmission, and utilization in the production and processing of biological materials.

**Credit hours:** 3

**Contact hours:** Lecture: 2 Lab: 2

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

## BAE 3223 Principles of Agriculture and Off-Road Machinery

**Prerequisites:** BAE 2023 and ENSC 2143 or consent of instructor.

**Description:** Principles of design, function, operation, testing and application of agricultural and off-road equipment and systems. Vehicle and implement system dynamics and hitching, and plant and soil interaction with machines. Machinery evaluation and standardized test procedures emphasizing safe and efficient performance of modern farm and off-road equipment.

**Credit hours:** 3

**Contact hours:** Lecture: 2 Lab: 2

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

**BAE 3313 Natural Resources Engineering**

**Prerequisites:** BAE 2023, STAT 2013, and ENSC 3233 or concurrent enrollment.

**Description:** Principles and practices of engineering analysis and design applied to hydrology, water quality, erosion and sedimentation, air quality, irrigation and animal waste management. Course previously offered as BAE 3323.

**Credit hours:** 3

**Contact hours:** Lecture: 2 Lab: 3

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

**BAE 4001 Professional Practice in Biosystems Engineering**

**Prerequisites:** Concurrent enrollment in BAE 4012.

**Description:** Preparation for professional practice through case studies about ethics, legal liability, safety, and societal issues. Practical professional communications experience.

**Credit hours:** 1

**Contact hours:** Other: 1

**Levels:** Undergraduate

**Schedule types:** Discussion

**Department/School:** Biosystems & Ag Eng

**BAE 4012 Senior Engineering Design Project I**

**Prerequisites:** Completion or concurrent enrollment in BAE 4001, BAE 3213; admission to professional school.

**Description:** Team work on professional level design projects, using design procedures to develop specifications, propose alternative solutions, consider external constraints, develop drawings or plans, construct, test and evaluate designs.

**Credit hours:** 2

**Contact hours:** Lecture: 1 Lab: 2

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

**BAE 4023 Senior Engineering Design Project II**

**Prerequisites:** Completion or concurrent enrollment in BAE 4012, BAE 3013, BAE 3023.

**Description:** Second of two-semester sequence of senior design courses. Course previously offered as BAE 4022.

**Credit hours:** 3

**Contact hours:** Lecture: 1 Lab: 4

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

**BAE 4213 Precision Agriculture**

**Prerequisites:** MATH 1513, senior standing.

**Description:** Introduction to the concepts of precision agriculture including analysis of spatial variability, relationships of fertility and crop response, geographical information systems, variable rate technology, optical sensing, global positioning systems, and yield monitoring. Case studies included for detailed analyses. Same course as SOIL 4213.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Graduate, Undergraduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

**BAE 4224 Machinery for Production and Processing**

**Prerequisites:** BAE 3213.

**Description:** Analysis and design of machine components and machine systems for production and processing of biological materials. Soil dynamics with emphasis on traction and soil compaction. Interactions of machines with biological systems. Course previously offered as BAE 4223.

**Credit hours:** 4

**Contact hours:** Lecture: 4

**Levels:** Graduate, Undergraduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

**BAE 4283 Bioprocess Engineering**

**Prerequisites:** BAE 3013, BAE 3113 or consent of instructor, ENSC 3233.

**Description:** Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up and downstream processing. Same course as CHE 4283.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Graduate, Undergraduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

**BAE 4314 Design Hydrology**

**Prerequisites:** BAE 2023 and ENSC 3233, and STAT 4033 or STAT 4073, or concurrent.

**Description:** Basic principles of surface and groundwater hydrology and their application in engineering problems. The hydrologic cycle, weather and hydrology, precipitation, evaporation, transpiration, subsurface waters, stream flow hydrographs, hydrologic and hydraulic stream routing, probability of hydrologic events and application of hydrologic models. Laboratory component will emphasize the application of hydrologic and hydraulic models and the quantification of hydrologic and hydraulic parameters. Course previously offered as BAE 4313.

**Credit hours:** 4

**Contact hours:** Lecture: 3 Lab: 2

**Levels:** Graduate, Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

**BAE 4324 Water Quality Engineering**

**Prerequisites:** BAE 4314 or CIVE 3843.

**Description:** Point and nonpoint source pollution processes, including transport mechanisms, and contaminant fate, control and remediation. Other topics include principles of ecological engineering, water body assessment and integrated watershed management.

**Credit hours:** 4

**Contact hours:** Lecture: 3 Lab: 3

**Levels:** Graduate, Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

**BAE 4400 Special Problems**

**Description:** Investigations in specialized areas of biosystems engineering. Offered for variable credit, 1-4 credit hours, maximum of 8 credit hours.

**Credit hours:** 1-4

**Contact hours:** Other: 1

**Levels:** Undergraduate

**Schedule types:** Independent Study

**Department/School:** Biosystems & Ag Eng

**BAE 4413 Food Engineering****Prerequisites:** BAE 3013 and ENSC 3233, ENSC 2213.**Description:** Analysis and design of various unit operations in food processing including thermal processing, drying, evaporation, freezing, processing non-Newtonian fluids and quality changes during processing. Course previously offered as BAE 4423.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate, Undergraduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 5000 Master's Research and Thesis****Prerequisites:** Consent of major professor.**Description:** Research and thesis writing. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Other: 1**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Biosystems & Ag Eng**BAE 5030 Problems in Biosystems Engineering and Agricultural Technology****Prerequisites:** Consent of instructor.**Description:** Problems associated with biosystems engineering and agricultural technology. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Other: 1**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Biosystems & Ag Eng**BAE 5213 Renewable Energy Engineering****Prerequisites:** ENSC 2213, ENSC 3233 or consent of instructor.**Description:** Renewable technologies such as solar, wind, geothermal, hydroelectric, and biomass to generate energy for electricity, heating, transportation, and other uses.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 5233 Bioseparations****Prerequisites:** BAE 3013 or CHE 3013.**Description:** Study of separations important in food and biochemical engineering such as leaching, extraction, expression, absorption, ion exchange, filtration, centrifugation, membrane separation, and chromatographic separations. Course available online only through AG\*IDEA consortium.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 5243 Biological Conversion for Advanced Biofuels****Prerequisites:** ENSC 2213.**Description:** Fundamental principles and applications of converting biomass to advanced biofuels. Focus will be on biological processes, fermentor design and operation, product recovery and emerging fuels.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 5283 Advanced Bioprocess Engineering****Prerequisites:** Consent of instructor.**Description:** Application of fundamental engineering principles to biochemical and biological processes. Introduction to cellular processes, fermentation technology, biological mass transfer and kinetics, bioreactor design and scale-up and downstream processing. Same course as CHE 5283.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biosystems & Ag Eng**BAE 5313 Watershed Modeling****Prerequisites:** BAE 4313 or equivalent.**Description:** A computer modeling course with an emphasis on chemical and physical processes governing nonpoint source pollution (nitrogen, phosphorus, sediment) at the basin scale. The laboratory use of state-of-the-art models applied to a variety of agricultural systems. "Hands on" use of comprehensive hydrologic water quality models that utilize spatial data in a geographic information system. Models and parameter uncertainty, digital data sources, parameter estimation and model testing, calibration and validation. For students with advanced personal computer skills.**Credit hours:** 3**Contact hours:** Lecture: 1 Lab: 6**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Biosystems & Ag Eng**BAE 5324 Modeling and Design in Storm Water and Sediment Control****Prerequisites:** BAE 4313 or equivalent.**Description:** Analysis and design of storm water, sediment and water quality systems with a focus on application to urban areas and developments in the urban-rural fringe. Advanced concepts in hydrologic modeling with kinematics, diffusion and dynamic modeling of flow; soil erosion, sediment transport and sediment control; storm water quality modeling and the impact of best management practices. In laboratories, use of hydrologic, sediment, and water quality models in analysis and design for real-world problems.**Credit hours:** 4**Contact hours:** Lecture: 3 Lab: 3**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Biosystems & Ag Eng

**BAE 5333 Applied Water Resources Statistics**

**Prerequisites:** STAT 5013 or equivalent.

**Description:** Applied statistical methods for hydrologists, engineers, and environmental scientists for analysis of environmental data. Parametric and nonparametric methods and exploratory data analysis applied to observed environmental data sets. Laboratory exercises emphasize hands-on application of statistical problems to reinforce concepts.

**Credit hours:** 3

**Contact hours:** Lecture: 2 Lab: 3

**Levels:** Graduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

**BAE 5343 Environmental Contaminant Transport**

**Prerequisites:** BAE 4313.

**Description:** Conceptual and mathematical models for the transport of contaminants in natural systems with an emphasis on agricultural pollutants. Basic transport processes relevant to the three environmental media - air, water, and soil. Common features underlying pollutant transport.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

**BAE 5353 Environmental and Ecological Risk Assessment**

**Prerequisites:** Graduate standing.

**Description:** Process and methodologies associated with human, environmental and ecological risks. Will quantify uncertainty in human perturbation, management, and restoration of environmental and ecological processes. Course available online only through AG\*IDEA consortium.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

**BAE 5363 Life Cycle Assessment**

**Prerequisites:** Graduate standing.

**Description:** Design of high level life cycle impact assessment for products, international standards for LCA, implications of functional unit and system boundary choices on comparative LCA. Course available online only through AG\*IDEA consortium.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

**BAE 5413 Advanced Instrumentation and Control Systems for Biological Applications**

**Prerequisites:** BAE 3023 or equivalent.

**Description:** Principles and operation of commercial instruments and data acquisition systems used in biological, environmental, and agricultural applications. Hands-on projects that will improve system design, development and programming skills. Introduction of advanced topics including machine vision, spectroscopy, and data communication networks.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

**BAE 5423 Food Rheology**

**Prerequisites:** ENSC 3233.

**Description:** Characterization and analysis of the rheological properties of food products. Focus on measurement techniques and equipment, including tube and rotational type instruments, with specific applications in food processing.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Lab: 2

**Levels:** Graduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biosystems & Ag Eng

**BAE 5433 Biosensors**

**Prerequisites:** PHYS 2114 and CHEM 3053 or equivalent.

**Description:** Principles and applications of biosensors in food analysis, disease diagnostics, and environmental monitoring. Emphasis on conceptual design and characterization of biosensors. Introduction to recent advances in biodetection using nanotechnology.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

**BAE 5501 Seminar**

**Description:** Discussion of current literature with special emphasis on research and experimental techniques.

**Credit hours:** 1

**Contact hours:** Other: 1

**Levels:** Graduate

**Schedule types:** Discussion

**Department/School:** Biosystems & Ag Eng

**BAE 6000 Doctoral Research and Dissertation**

**Prerequisites:** Approval by the student's advisory committee.

**Description:** Research and doctoral dissertation preparation. Offered for variable credit, 1-10 credit hours, maximum of 42 credit hours.

**Credit hours:** 1-10

**Contact hours:** Other: 1

**Levels:** Graduate

**Schedule types:** Independent Study

**Department/School:** Biosystems & Ag Eng

**BAE 6101 Teaching Practicum in Biosystems Engineering**

**Prerequisites:** One semester of doctoral study in Biosystems Engineering, or consent of instructor.

**Description:** Philosophies and techniques of resident and non-resident teaching, including experiences in preparation, presentation, and evaluation of lectures, laboratories, extension or continuing education programs. Course previously offered as BAE 6100.

**Credit hours:** 1

**Contact hours:** Lab: 2 Other: 1

**Levels:** Graduate

**Schedule types:** Independent Study, Lab, Combined lab & IS

**Department/School:** Biosystems & Ag Eng

**BAE 6213 Advanced Biomass Thermochemical Conversion**

**Prerequisites:** ENSC 2213.

**Description:** Advanced study, evaluation, and application of thermochemical conversion pathways in biofuel production. Specific topics include biomass gasification, pyrolysis, liquefaction, and heterogeneous catalysis. Course available online only through AG\*IDEA consortium. Course previously offered as BAE 6100.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

**BAE 6313 Stochastic Methods in Hydrology**

**Prerequisites:** CIVE 5843, STAT 4033.

**Description:** Stochastic and statistical hydrologic analyses of surface water and groundwater systems. Analysis of urban and rural drainage and detention systems. Same course as CIVE 6843.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

**BAE 6333 Fluvial Hydraulics**

**Prerequisites:** BAE 3013 or equivalent.

**Description:** Principles of sediment detachment and transport in fluvial systems. Design of stable channels and flow resistance relationships for sediment-laden flows.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

**BAE 6343 Ground Water Contaminant Transport**

**Prerequisites:** SOIL 5583 or CIVE 5913 or GEOL 5453.

**Description:** Principles of solute and multiphase transport in soils and ground water. Effects of advection, diffusion, dispersion, degradation, volatilization and adsorption. Relationships between laboratory and field scale transport. Contamination by nonaqueous phase liquids.

**Credit hours:** 3

**Contact hours:** Lecture: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biosystems & Ag Eng

**BAE 6520 Problems in Soil and Water Engineering**

**Prerequisites:** Consent of instructor.

**Description:** Consent of instructor. Problems associated with erosion control, drainage, flood protection and irrigation. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.

**Credit hours:** 2-6

**Contact hours:** Other: 2

**Levels:** Graduate

**Schedule types:** Independent Study

**Department/School:** Biosystems & Ag Eng

**BAE 6540 Prob Farm Power & Mach**

**Prerequisites:** Consent of instructor.

**Description:** Literature review and analytical studies of selected farm power and machinery problems. Written report required. Offered for variable credit, 2-6 credit hours, maximum of 6 credit hours.

**Credit hours:** 2-6

**Contact hours:** Other: 2

**Levels:** Graduate

**Schedule types:** Independent Study

**Department/School:** Biosystems & Ag Eng

**BAE 6580 Problems in Transport Processes**

**Prerequisites:** Consent of instructor.

**Description:** Literature review and analysis of heat and mass transport and interval diffusion in biological materials. Transport phenomena at interfaces, thermal and cryogenic processing, drying, packed and fluidized bed systems. Thermal and moisture control processing affecting quality of food products. Written report required. Offered for variable credit, 2-6 credit hours, maximum of 6 credit hours.

**Credit hours:** 2-6

**Contact hours:** Other: 2

**Levels:** Graduate

**Schedule types:** Independent Study

**Department/School:** Biosystems & Ag Eng

**BAE 6610 Adv Research & Study**

**Prerequisites:** Approval by the student's advisory committee.

**Description:** Research and study at the doctoral level on the topic related to the student's doctoral program and field of interest. Offered for variable credit, 1-10 credit hours, maximum of 20 credit hours.

**Credit hours:** 1-10

**Contact hours:** Other: 1

**Levels:** Graduate

**Schedule types:** Independent Study

**Department/School:** Biosystems & Ag Eng