BIOLOGICAL SYSTEMS ENGINEERING (BSEN)

BSEN 100 Introduction to Biological Engineering and Agricultural Engineering
Crosslisted with: AGEN 100
Description: Description of careers in biomedical, environmental, water resources, food and bioproducts, and agricultural engineering. The human, economic and environmental impacts of engineering in society. Communication, design, teamwork, and the role of ethics and professionalism in engineering work.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC
Prerequisite for: AG 112, BSEN 112

BSEN 112 Computer-Aided Problem-Solving
Crosslisted with: AGEN 112
Prerequisites: BSEN 100/AGEN 100 and high school physics, or permission
Description: Problem solving techniques and procedures through the use of Excel, MATLAB, and graphical methods. Emphasis on problem/solution communications with topics and problems from agricultural engineering and biological systems engineering.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC
Prerequisite for: BSEN 212A, BSEN 212A; BSEN 212B, BSEN 212B; BSEN 212C, BSEN 212C

BSEN 130 Computer-Aided Design
Crosslisted with: CIVE 130
Description: Use of computer-aided design software to communicate engineering ideas. Specifications, dimensioning, tolerancing, 2- and 3-D model development, topographic mapping, and process layout with environmental, bioprocess, and biomedical emphases.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC
Prerequisite for: AG 470, BSEN 470

BSEN 206 Engineering Economics
Crosslisted with: CONE 206
Prerequisites: Sophomore standing
Description: Introduction to methods of economic comparisons of engineering alternatives: time value of money, depreciation, taxes, concepts of accounting, activity-based costing, ethical principles, civics and stewardship, and their importance to society.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: MECH 343
ACE: ACE 8 Civic/Ethics/Stewardship

BSEN 212A Computational Tools & Modeling for Agricultural & Biological Systems Eng: MATLAB
Crosslisted with: AGEN 212A
Prerequisites: AGEN or BSEN 112/112H; or permission
Description: Introduction to tools needed to develop computation-intensive solutions for a wide variety of problems relevant to agricultural and biological systems engineering. Advanced problem solving techniques are illustrated using examples of scripts.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC
Prerequisite for: BSEN 311; MECH 350

BSEN 212B Computational Tools & Modeling for Ag & Biological Sys Engr: Control Systems
Crosslisted with: AGEN 212B
Prerequisites: AGEN or BSEN 112/112H; ELEC 211 or ELEC 213 or PHYS 212, or parallel; or permission
Notes: This is a 5-week mini-course in which the lab time entails a combination of a 2nd lecture and followup laboratory applications.
Description: Introduction to microcontroller based embedded systems for agricultural and biological applications. Fundamental principles of microcontrollers and embedded systems through binary and hexadecimal number systems, digital logic, programming in integrated development environment, and microcontroller peripherals. Common agricultural and biological microcontroller input and output devices.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

BSEN 212C Computational Tools & Modeling for Agricultural & Biological Systems Eng: LabVIEW
Crosslisted with: AGEN 212C
Prerequisites: AGEN or BSEN 112/112H; or permission
Description: Introduction to tools needed to develop computation-intensive solutions for a wide variety of problems relevant to agricultural and biological systems engineering. Advanced problem solving techniques are illustrated using examples of scripts, simulation methods, graphical programming, and their combination.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

BSEN 225 Engineering Properties of Biological Materials
Crosslisted with: AGEN 225
Prerequisites: MATH 106
Description: Physical properties important to the design of harvesting, storage, and processing systems for agricultural crops; principles and techniques for measurement of properties including frictional effects, particle size, strength, moisture content, specific heat, and thermal conductivity.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: AGEN 324, BSEN 324
BSEN 244 Thermodynamics of Living Systems  
**Prerequisites:** BIOS 101 and 101L, or BIOS 102, CHEM 110 or 114, MATH 208 and PHYS 211.  
**Description:** Introduction to the laws of thermodynamics and their application to biological and environmental systems. Zeroth, first, second, and third laws; open and closed systems; enthalpy and specific heat; and Gibbs's free energy and chemical potential for biological and environmental systems. Applications to biochemical potentials, water potential, absorption, osmosis, radiation, membranes, surface tension, and fugacity. Thermodynamic cycles as they apply to living systems.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Prerequisite for:** AGEN 344, BSEN 344

BSEN 303 Principles of Process Engineering  
**Crosslisted with:** AGEN 303  
**Prerequisites:** MATH 221 or permission.  
**Description:** Introduction to performance parameters and characteristics of pumps, fans, presses, and solids handling, size reduction, separation and agitation equipment. Application of the various technologies studied with analysis of example systems.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

BSEN 311 Biomedical Signal and System Analysis  
**Prerequisites:** MATH 221; and BSEN 212A or equivalent  
**Description:** Mathematical modeling of biophysical systems. Continuous and discrete signals. Signal representation, system classification, impulse response, convolution, Fourier analysis, transfer functions, difference-equation approximations of differential equations. Basic filtering concepts.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

BSEN 317 Introduction to Biomedical Engineering  
**Prerequisites:** PHYS 211; MATH 221 or parallel and one semester of biology  
**Description:** Research areas and applications related to biomedical engineering including bioelectricity, biosensors, biomechanics, cardiovascular mechanics, tissue engineering, biotechnology, and medical imaging. Identifying engineering methods used to develop biomedical technologies and communicating technical knowledge to a wide variety of audiences.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

BSEN 324 Mechanics of Materials for Agricultural and Biological Systems Engineering  
**Crosslisted with:** AGEN 324  
**Prerequisites:** AGEN/BSEN 225, MECH 223  
**Description:** Development of the concepts of stress and strain relevant to agricultural and biological systems. Stress analysis of axial, torsional, and bending stresses, combined loading analysis, deflection evaluation, static and dynamic failure theory. Practical applications in agricultural and biological systems will be discussed.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

BSEN 325 Power Systems Design  
**Crosslisted with:** AGEN 325  
**Prerequisites:** PHYS 212 or ELEC 211, and MECH/CIVE 310 or CHME 332 or parallel or permission.  
**Description:** Fundamentals of Power systems for machines. Introduction to fluid power (hydraulics, pneumatics), pumps, motors, cylinders, control devices and system design. Selection of electric motors as power sources, operating characteristics and circuits. Selection of internal combustion engines as power sources.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC

BSEN 326 Introduction to Environmental Engineering  
**Crosslisted with:** CIVE 326  
**Prerequisites:** CHEM 110 or 111 or 113 and MATH 221  
**Description:** Introduction to principles of environmental engineering including water quality, atmospheric quality, pollution prevention, and solid and hazardous wastes engineering. Design of water, air, and waste management systems.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC  
**Prerequisite for:** BSEN 425, CIVE 425

BSEN 326H Honors: Introduction to Environmental Engineering  
**Crosslisted with:** CIVE 326H  
**Prerequisites:** Good standing in the University Honors Program or by invitation: CHEM 110 or 111 or 113, MATH 221.  
**Description:** Introduction to principles of environmental engineering including water quality, atmospheric quality, pollution prevention, and solid and hazardous wastes engineering. Design of water, air, and waste management systems.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Format:** LEC
BSEN 327 Environmental Engineering Laboratory
Crosslisted with: CIVE 327
Prerequisites: CIVE 327
Description: Environmental engineering experiments, demonstrations, field trips, and projects. Experiments include the measurement and determination of environmental quality parameters such as solids, dissolved oxygen, biochemical and chemical oxygen demand, and alkalinity.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

BSEN 344 Biological and Environmental Transport Processes
Crosslisted with: AGEN 344
Prerequisites: BSEN 244 or MECH 200; MATH 221; MECH/CIVE 310 or CHME 332 or parallel; or permission
Description: Introduction to concurrent transport of energy and mass in biological and environmental processes. Modes of heat transfer, steady and non-steady state heat conduction, convective heat transfer, radiative heat transfer, and heat transfer with phase change. Equilibrium, kinetics, and modes of mass transfer, diffusion, dispersion, and convective mass transfer. Soil freezing and thawing, energy and mass balances of crops, diffusivities of membranes, photosynthesis, human and animal energy balances, and respiration.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: AGEN 470, BSEN 470

BSEN 350 Soil and Water Resources Engineering
Crosslisted with: AGEN 350
Prerequisites: MATH 221 and parallel: MECH/CIVE 310 or CHME 332.
Description: Introduction to soil and water resources and the engineering processes used to analyze watersheds. Soil water relations, evapotranspiration, precipitation, runoff, erosion, flow in natural waterways and through reservoirs, wetland and groundwater hydrology, and water quality. Geographic information system utilized to develop maps and analyze watershed characteristics. A selected watershed is investigated.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: AGEN 957, BSEN 957, CIVE 957, GEOL 957

BSEN 355 Introduction to Ecological Engineering
Prerequisites: CHEM 110 or 111 or 113, and MATH 221.
Description: Environmental engineering experiments, demonstrations, field trips, and projects. Experiments include the measurement and determination of environmental quality parameters such as solids, dissolved oxygen, biochemical and chemical oxygen demand, and alkalinity.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

BSEN 395 Internship in Agricultural and Biological Systems Engineering
Crosslisted with: AGEN 395
Prerequisites: Permission
Notes: Completion of internship approval form is required. The internship proposal is subject to approval by the Department of Biological Systems Engineering.
Description: Practical experience, directed learning, and career exploration and development in a selected business, industry, agency, or educational institution. Activities must include a significant engineering component.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Format: FLD

BSEN 414 Medical Imaging Systems
Crosslisted with: BSEN 814
Prerequisites: BSEN 311 or ELEC 304
Description: Underlying physics, instrumentation, and signal analysis of biomedical and biological imaging modalities. MRI, X-ray, CT, ultrasound, nuclear medicine, and the human visual system. Energy-tissue interactions. Resolution, point spread function, contrast, diffraction, comparisons. Information content in images for biological systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

BSEN 416 Introduction to Biomaterials
Crosslisted with: BSEN 816
Prerequisites: BSEN/AGEN 225; BIOC 321 or BIOC/BIOS/CHEM 431/831.
Notes: BSEN 416/816 requires the evaluation of current primary literature in the field.
Description: Introduction to all types of bio-materials, metals, ceramics, polymers, and natural materials. Characterization of biomaterials, mechanical and physical properties, cell-biomaterials interactions, degradation, and host reaction to biomaterials. FDA testing and applications of biomaterials, implants, tissue engineering scaffolds, artificial organs, drug delivery, and adhesives.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: BSEN 418, BSEN 818

BSEN 418 Tissue Engineering
Crosslisted with: BSEN 818
Prerequisites: BSEN 416/816 or equivalent
Notes: BSEN 418/818 uses case studies to demonstrate clinical implementation of engineered tissues.
Description: Introduction to engineering biological substitutes that can restore, maintain or improve organ function in therapy of diseases. Engineering methods and principles to design tissues and organs, cell and tissue biology, tissue growth and development, biomaterial scaffolds, growth factor and drug delivery, scaffold-cell interactions, and bioreactors.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
BSEN 422 Pollution Prevention: Principles and Practices
Crosslisted with: BSEN 822, CIVE 422, CIVE 822
Prerequisites: Permission.
Description: Introduction to pollution prevention (P2) and waste minimization methods. Practical applications to small businesses and industries. Legislative and historical development of P2 systems analysis, waste estimation, P2 methods, P2 economics, and sources of P2 information.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

BSEN 425 Process Design in Water Supply and Wastewater Treatment
Crosslisted with: CIVE 425
Prerequisites: CIVE/BSEN 326 and CIVE/MECH 310.
Description: Design of unit operations and processes associated with drinking water and wastewater treatment facilities.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

BSEN 441 Animal Waste Management
Crosslisted with: AGEN 441, AGEN 841, BSEN 841
Prerequisites: Senior standing.
Description: Characterization of wastes from animal production. Specification and design of collection, transport, storage, treatment, and land application systems. Air and water pollution, regulatory and management aspects.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

BSEN 444 Biomass and Bioenergy Engineering
Crosslisted with: BSEN 844
Prerequisites: Senior/graduate standing in engineering; BIOC 321 or 431; or permission
Description: Engineering processes for biomass conversion and bioenergy production. Topics include biomass chemistry, conversion reactions, current and emerging bioenergy technologies, feedstock logistics, life cycle assessment. Analysis of primary research literature required for graduate credit.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

BSEN 446 Unit Operations of Biological Processing
Crosslisted with: BSEN 846, AGEN 446, AGEN 846
Prerequisites: AGEN 225 or BSEN 225 and CHEM 332 or equivalent.
Description: Application of heat, mass, and moment transport in analysis and design of unit operations for biological and agricultural materials. Evaporation, drying, distillation, extraction, leaching, thermal processing, membrane separation, centrifugation, and filtration.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

BSEN 453 Irrigation and Drainage Systems Engineering
Crosslisted with: AGEN 453, AGEN 853, BSEN 853
Prerequisites: CIVE 310 or MECH 310; AGEN 344 or BSEN 344; or permission.
Description: Analytical and design consideration of evapotranspiration, soil moisture, and water movement as related to irrigation and drainage systems; analysis and design of components of irrigation and drainage systems including water supplies, pumping plants, sprinkler systems, and center pivots.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

BSEN 455 Nonpoint Source Pollution Control Engineering
Crosslisted with: BSEN 855, CIVE 455, CIVE 855
Prerequisites: BSEN 326 or CIVE 326; BSEN 350 or AGEN 350 or CIVE 352.
Description: Identification, characterization, and assessment of nonpoint source pollutants; transport mechanisms and remediation technologies; design methodologies and case studies.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

BSEN 458 Groundwater Engineering
Crosslisted with: BSEN 858, CIVE 458, CIVE 858
Prerequisites: CIVE 352 or AGEN 350 or BSEN 350 or equivalent.
Description: Application of engineering principles to the movement of groundwater. Analysis and design of wells, well fields, and artificial recharge. Analysis of pollutant movement.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

BSEN 460 Instrumentation and Controls
Crosslisted with: AGEN 460, AGEN 860, BSEN 860
Prerequisites: ELEC 211 or ELEC 215; or permission
Description: Analysis and design of instrumentation and controls for agricultural and biological production, management and processing. Theory of basic sensors and transducers, analog and digital electrical control circuits, and the interfacing of computers with instruments and controls. Emphasis on signal analysis and interpretation for improving system performance.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
BSEN 470 Design I in Agricultural and Biological Systems Engineering  
Crosslisted with: AGEN 470  
Prerequisites: BSEN or MECH 130 and AGEN or BSEN 344; Prereq or Parallel: AGEN or BSEN 460 and at least two courses from primary emphasis area; or permission  
Description: Definition, scope, analysis, and synthesis of a comprehensive design problem within the areas of emphasis in the Department of Biological Systems Engineering. Identification of a client's engineering problem to solve, and development of objectives and anticipated results.  
Credit Hours: 1  
Max credits per semester: 1  
Max credits per degree: 1  
Format: LEC  
Prerequisite for: AGEN 480, BSEN 480  

BSEN 479 Hydroclimatology  
Crosslisted with: NRES 479, METR 479, WATS 479, NRES 879, METR 879, BSEN 879  
Prerequisites: NRES 208 or METR 100 or METR/NRES 370.  
Notes: Offered spring semester of even-numbered calendar years.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LEC  

BSEN 480 Design II in Agricultural and Biological Systems Engineering  
Crosslisted with: AGEN 480  
Prerequisites: BSEN/AGEN 470  
Description: Definition, scope, analysis, and synthesis of a comprehensive engineering problem in an engineering area of emphasis within the Department of Biological Systems Engineering. Design activity using the team approach to develop a solution.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Format: LAB  
ACE: ACE 10 Integrated Product  

BSEN 492 Special Topics  
Crosslisted with: BSEN 892  
Prerequisites: Permission  
Description: Subject matter in emerging areas of Biological Systems Engineering not covered in other courses within the curriculum. Topics, activities, and delivery methods vary.  
Credit Hours: 1-6  
Min credits per semester: 1  
Max credits per semester: 6  
Max credits per degree: 6  
Format: LEC  

BSEN 496 Independent Study  
Crosslisted with: AGEN 496  
Prerequisites: Permission  
Notes: Topics vary.  
Description: Investigation and written report on engineering problems not covered in sufficient depth through existing courses.  
Credit Hours: 1-6  
Min credits per semester: 1  
Max credits per semester: 6  
Max credits per degree: 6  
Format: IND  

BSEN 499H Honors Thesis  
Crosslisted with: AGEN 499H  
Prerequisites: Senior or junior standing, admission to the University Honors Program.  
Description: Independent project which meets the requirements of the University Honors Program, conducted under the guidance of a faculty member in the Department of Biological Systems Engineering. The project should contribute to the advancement of knowledge in the field. Written thesis and formal presentation required.  
Credit Hours: 1-6  
Min credits per semester: 1  
Max credits per semester: 6  
Max credits per degree: 6  
Format: IND