BIOLOGICAL SYSTEMS ENGINEERING (BSEN)

BSEN 812 Rehabilitation Engineering
Crosslisted with: BSEN 412
Description: Application of engineering methods to the development of assistive technology for people with injuries and disabilities. Characterization of the physical and mental capabilities of people with impairment, universal design, assistive technologies associated with seating, transportation, communication, and recreation. Integration of engineering design principles in a rehabilitation design project.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

BSEN 814 Medical Imaging Systems
Crosslisted with: BSEN 414
Prerequisites: BSEN 311 or ECEN 304
Description: Underlying physics, instrumentation, and signal analysis of biomedical and 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
Grading Option: Grade Pass/No Pass Option

BSEN 815 Introduction to Magnetic Resonance Imaging
Prerequisites: Familiarity with linear systems theory (e.g. BSEN 311 or ELEC 304) and MATLAB programming preferred; however, these topics are reviewed for clinicians and bio science students wishing to take the class
Description: Introduction to the physics, techniques, and biomedical applications of magnetic resonance imaging (MRI) in basic sciences and the clinic. Fundamentals of nuclear magnetic resonance physics, Fourier transforms, MRI hardware, and MRI principles including signal generation, detection and spatial localization techniques. Applications of MRI including tissue relaxometry and diffusion weighted imaging applications to diseases, traumatic brain injury, and cancer.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 816 Introduction to Biomaterials
Crosslisted with: BSEN 416
Prerequisites: BSEN/AGEN 225 or MECH 325; BIOC 401 or BIOC 431
Notes: 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
Grading Option: Grade Pass/No Pass Option
Prerequisite for: BSEN 418, BSEN 818

BSEN 818 Tissue Engineering
Crosslisted with: BSEN 418
Prerequisites: BSEN 416/816 or equivalent
Notes: 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
Grading Option: Grade Pass/No Pass Option

BSEN 822 Pollution Prevention: Principles and Practices
Crosslisted with: BSEN 422, 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
Grading Option: Grade Pass/No Pass Option

BSEN 841 Animal Waste Management
Crosslisted with: AGEN 441, AGEN 841, BSEN 441
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
Grading Option: Grade Pass/No Pass Option

BSEN 844 Biomass and Bioenergy Engineering
Crosslisted with: BSEN 444
Prerequisites: Senior/graduate standing in engineering; BIOC 401 or 431
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
Grading Option: Grade Pass/No Pass Option

BSEN 845 Ag Bioprocessing Engineering
Crosslisted with: BSEN 445
Prerequisites: Senior/graduate standing in engineering; BIOC 401 or 431
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
Grading Option: Grade Pass/No Pass Option
BSEN 845 Bioprocess Engineering
Crosslisted with: BSEN 445
Prerequisites: BIOC 401 or BIOC 431; BSEN 303, BSEN 344
Description: Engineering topics related to processing of biological materials into valuable products. Enzyme kinetics, microbial kinetics, application of enzymes in industrial processes, bioreactor design, equipment scale-up, gas transfer in reactors and bioseparations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL

BSEN 846 Unit Operations of Biological Processing
Crosslisted with: BSEN 446, AGEN 446, AGEN 846
Prerequisites: AGEN/BS 225; and AGEN/BS 344
Description: Application of heat, mass, and moment transport in analysis and design of unit operations for biological and agricultural materials. 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
Grading Option: Grade Pass/No Pass Option
Offered: SPRING
Prerequisite for: BSEN 935

BSEN 853 Irrigation and Drainage Systems Engineering
Crosslisted with: AGEN 453, AGEN 853, BSEN 453
Prerequisites: CIVE 310 or MECH 310; AGEN 344 or BSEN 344
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
Grading Option: Grade Pass/No Pass Option
Prerequisite for: AGEN 953

BSEN 858 Groundwater Engineering
Crosslisted with: BSEN 458, CIVE 458, CIVE 858
Prerequisites: CIVE 352 or AGRO 350 or BSEN 350
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
Grading Option: Grade Pass/No Pass Option
Prerequisite for: AGRO 955, AGRO 955, CIVE 955, GEOL 985

BSEN 860 Instrumentation and Controls
Crosslisted with: AGEN 460, AGEN 860, BSEN 460
Prerequisites: ELEC 211 or ELEC 215
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
Grading Option: Grade Pass/No Pass Option

BSEN 858 Groundwater Engineering
Crosslisted with: BSEN 458, NRES 458, NRES 858, WATS 468, BSEN 468
Prerequisites: CHEM 109 and CHEM 110, or CHEM 105 and CHEM 106; Junior or Senior Standing.
Notes: Offered even-numbered calendar years.
Description: Physical, chemical and biological processes that occur in wetlands; the hydrology and soils of wetland systems; organisms occurring in wetlands and their ecology wetland creation, delineation, management and ecotoxicology.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Grade Pass/No Pass Option

BSEN 868 Wetlands
Crosslisted with: BIOS 458, NRES 458, NRES 858, WATS 468, BSEN 468
Prerequisites: CHEM 109 and CHEM 110, or CHEM 105 and CHEM 106; Junior or Senior Standing.
Notes: Offered even-numbered calendar years.
Description: Physical, chemical and biological processes that occur in wetlands; the hydrology and soils of wetland systems; organisms occurring in wetlands and their ecology wetland creation, delineation, management and ecotoxicology.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Grade Pass/No Pass Option

BSEN 879 Hydroclimatology
Crosslisted with: NRES 479, METR 479, WATS 479, BSEN 479, NRES 879, METR 879
Prerequisites: NRES 208 or METR 100 or METR/NRES 370.
Notes: Offered fall semester of even-numbered calendar years.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 889 Seminar I
Crosslisted with: AGEN 889
Description: Introduction into departmental and campus resources, professionalism, preparation and delivery of presentations, technical writing, and additional topics as arranged by enrolled students.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Grade Pass/No Pass Option
BSEN 892 Special Topics
Crosslisted with: BSEN 492
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
Grading Option: Graded

BSEN 896 Special Problems
Crosslisted with: AGEN 896
Prerequisites: Permission
Description: Investigation and written report on engineering problems not covered in sufficient depth through existing courses. Topic varies by semester.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Grade Pass/No Pass Option

BSEN 897 Masters Project
Crosslisted with: AGEN 897, MSYM 897
Prerequisites: Admission to M.S. in Agricultural and Biological Systems Engineering or M.S. in Mechanized Systems Management, and permission of major advisor
Notes: Intended for students who are pursuing an Option II or III master's degree in Agricultural and Biological Systems Engineering, or Mechanized Systems Management.
Description: Conception, design, development, and completion of a project that requires data collection, synthesis, analysis of results, and the development of a final written report that will be defended in the final oral examination.
Credit Hours: 3-6
Min credits per semester: 3
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Pass No-Pass

BSEN 898 Internship
Crosslisted with: AGEN 898
Prerequisites: Permission
Notes: Students required to write an internship report of their creative accomplishments after completion of the internship. Students may spend up to nine months at the cooperating partner's workplace.
Description: Solution of engineering or management problems through a non-academic experience within the private sector or a government agency. The experience entails all or some of the following: research, design, analysis, and testing on an engineering problem. A plan, which documents how the individual will demonstrate creativity during the internship must be approved prior to the internship.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Grade Pass/No Pass Option

BSEN 899 Masters Thesis
Prerequisites: Admission to masters degree program and permission of major adviser
Credit Hours: 1-10
Min credits per semester: 1
Max credits per semester: 10
Max credits per degree: 99
Grading Option: Pass No-Pass

BSEN 912 Advanced Ultrasound Imaging
Prerequisites: BSEN 311 or ELEC 304 Engineering design and analysis of medical ultrasound applications
Description: Beamforming, diffraction, wave space, scattering, imaging. Interactions of mechanical energy and tissue. Linear and phased arrays. Doppler estimation of blood flow velocity. Tumor and clyt characterization. Other modern research topics in medical ultrasound.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 935 Analysis of Engineering Properties of Biological Materials
Prerequisites: BSEN 846 or equivalent
Description: Current and relevant mechanical, rheological, thermal, electrical, and optical properties as related to the engineering of processing, storage, handling, and utilization systems for biological materials are selected for analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 941 Agricultural Waste Management
Crosslisted with: AGEN 941
Prerequisites: Permission
Description: Aerobic, anaerobic, and physical-chemical treatment, energy recovery and protein synthesis processes for high-strength organic materials; agricultural applications including composting, ammonia stripping, nitrification, denitrification, and land disposal of organic and chemically treated materials.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 943 Bioenvironmental Engineering
Prerequisites: BSEN 941 or equivalent
Description: An engineer analysis of livestock, their environment and the interaction between the two; mathematical models, heat transfer, energy balances, environmental measurements, physiological measurements, calorimetry.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option

BSEN 951 Advanced Mathematical Modeling in Biological Engineering
Prerequisites: MATH 821
Description: Advanced mathematical modeling techniques and applications. Specific topics from current literature and vary depending on research interests.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Grade Pass/No Pass Option
BSEN 954 Turbulent Transfer in the Atmospheric Surface Layer  
Crosslisted with: NRES 954  
Prerequisites: MATH 821; MECH 310 or NRES 808 or BIOS 857; or equivalent  
Notes: Offered spring semester of odd-numbered calendar years.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Grading Option: Grade Pass/No Pass Option

BSEN 957 Modeling Vadose Zone Hydrology  
Crosslisted with: AGEN 957, CIVE 957, GEOL 957  
Prerequisites: MATH 221/821 or equivalent. AGEN/BSEN 350 or NRES 453/853 or equivalent.  
Notes: Typically offered spring semester in even years.  
Description: Principles and modeling of fluid flow and solute transport in the vadose zone. Topics include hydraulic properties of variably saturated media, application of Darcy's Law in variably saturated media, hydrologic and transport processes in the vadose zone, and solution of steady and unsteady flow problems using numerical techniques including finite element methods. Contemporary vadose zone models will be applied to engineering flow and transport problems. Review and synthesis of classic and contemporary research literature on vadose zone hydrology will be embedded in the course.  
Credit Hours: 3  
Max credits per semester: 3  
Max credits per degree: 3  
Grading Option: Grade Pass/No Pass Option  
Offered: SPRING

BSEN 989 Seminar II  
Crosslisted with: AGEN 989  
Description: Developing a graduate program, orientation to research, grant and research proposal preparation, experimental design and analysis, manuscript preparation and review, preparations and delivery of technical presentations, and research management.  
Credit Hours: 1  
Max credits per semester: 1  
Max credits per degree: 1  
Grading Option: Grade Pass/No Pass Option

BSEN 998 Advanced Topics  
Crosslisted with: AGEN 998  
Prerequisites: Permission  
Description: Individual study in advanced engineering topics that are not covered in regular course work or thesis. Topic varies by term.  
Credit Hours: 1-6  
Min credits per semester: 1  
Max credits per semester: 6  
Max credits per degree: 6  
Grading Option: Grade Pass/No Pass Option

BSEN 999 Doctoral Dissertation  
Prerequisites: Admission to doctoral degree program and permission of supervisory committee chair  
Credit Hours: 1-24  
Min credits per semester: 1  
Max credits per semester: 24  
Max credits per degree: 99  
Grading Option: Pass No-Pass