

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 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

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 Bioprocess Engineering

Crosslisted with: BSEN 445

Prerequisites: BSEN 344 or CHME 333

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/BSEN 225; and AGEN/BSEN 344

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

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 854, AGST 854; AGEN 953

BSEN 855 Nonpoint Source Pollution Control Engineering

Crosslisted with: BSEN 455, CIVE 455, CIVE 855

Prerequisites: BSEN 321/CIVE 321 or BSEN 355; AGEN/BSEN 350 or CIVE 352 as prerequisite or parallel.

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

Grading Option: Grade Pass/No Pass Option

Offered: FALL

BSEN 858 Groundwater Engineering

Crosslisted with: BSEN 458, CIVE 458, CIVE 858

Prerequisites: CIVE 352 or AGEN 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

BSEN 860 Instrumentation and Controls

Crosslisted with: AGEN 460, AGEN 860, BSEN 460

Prerequisites: ECEN 211 or ECEN 215 or AGEN/BSEN 260

Description: Analysis and design of instrumentation and controls for agricultural, biological, and biomedical applications. Theory of basic sensors and transducers, analog and digital electrical control circuits, and the interfacing of computers with instruments and controls. LabVIEW Programming. 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

Offered: FALL

BSEN 868 Wetlands

Crosslisted with: BIOS 458, NRES 468, NRES 868, WATS 468, BSEN 468

Prerequisites: CHEM 109A and 109L and CHEM 110A and 110L, or CHEM 105A and 105L and CHEM 106A and 106L; 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

Course and Laboratory Fee: \$40

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 spring semester of even-numbered calendar years.

Description: Interaction between earth's climate and the hydrologic cycle. Energy and water fluxes at the land-atmosphere interface. Atmospheric moisture transport, precipitation, evaporation, snowmelt, and runoff. Impacts of climate variability and change on the hydrologic cycle.

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, AGST 897**Prerequisites:** Admission to M.S. in Agricultural and Biological Systems Engineering or M.S. in Agricultural Systems Technology, 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 Agricultural Systems Technology.**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 910 Delivery of Nucleic Acids****Prerequisites:** Graduate Standing**Description:** Engineering methods and principles to design delivery systems that can transfer nucleic acids to mammalian cells, including viral, non-viral and physical techniques, and review of applications including vaccines and gene therapies.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Graded**Offered:** FALL**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 cyst 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 942 Antimicrobial Resistance from a One Health Perspective**Prerequisites:** Graduate Standing**Description:** Covers the fundamentals of antimicrobial resistant development, transmission, and risks to humans, animals and the environment delivered by experts in One Health fields (interconnection between people, animals, and their shared environment). Exposed to a variety of perspectives on the highly complex problem of AMR and the spectrum of the challenges and the opportunities of multidisciplinary efforts to address it. Expected to work together with their peers across the country to review and develop research-based resources and methods for communicating scientific information about AMR to non-academic audiences.**Credit Hours:** 1**Max credits per semester:** 1**Max credits per degree:** 1**Grading Option:** Graded**Offered:** SPRING**BSEN 943 Bioenvironmental Engineering****Prerequisites:** MATH 821**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****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