

BIOENGINEERING (BIOE)

BIOE 1000 Orientation and Introduction to Bioengineering Computing [0-2 credit hours]

Application of graphical design and numerical analysis software required for the solution of bioengineering problems. This course also provides a one-semester overview of key engineering principles and concepts.

Term Offered: Fall

BIOE 1010 Professional Development

[1 credit hour]

Preparation for co-op and full-time employment in industry. Topics include resume writing, interviewing skills, compensation and benefits, social protocol and corporate ethics, biomedical ethics, design and quality control processes and governmental regulation.

Prerequisites: BIOE 1200 with a minimum grade of D- and ENGL 1110 with a minimum grade of D

Term Offered: Spring

BIOE 1200 Introduction to Bioengineering Applications

[0-2 credit hours]

Application of graphical design and numerical analysis software required for the solution of bioengineering problems. This course also provides a one-semester overview of key engineering principles and concepts.

Prerequisites: BIOE 1000 with a minimum grade of D-

Term Offered: Spring

BIOE 1410 Freshman Design Innovation I

[1 credit hour]

Basic concepts for biomedical device design and development and incorporating innovation and entrepreneurial mindset in freshman bioengineering students using team- and project-based learning experiences.

Term Offered: Fall

BIOE 1420 Freshman Design Innovation II

[1 credit hour]

Basic concepts for biomedical device design and development and incorporating entrepreneurial mindset in freshman bioengineering students using team- and project-based learning experiences.

Prerequisites: BIOE 1410 with a minimum grade of D-

Term Offered: Spring

BIOE 2100 Bioengineering Thermodynamics

[0-3 credit hours]

Principles of thermodynamics and conservation of mass applied to living systems, biomedical devices and bioprocesses.

Prerequisites: PHYS 2130 with a minimum grade of D- and CHEM 1240 with a minimum grade of D- and MATH 2850 with a minimum grade of D- or MATH 2950 with a minimum grade of D-

Term Offered: Spring, Fall

BIOE 2200 Biomaterials

[3 credit hours]

Physical and chemical properties of materials commonly used in medicine. Topics include inflammatory, immunogenic, carcinogenic and toxicologic responses within host tissues as well as testing and evaluation strategies for effective use of materials in medicine and biology.

Prerequisites: PHYS 2130 with a minimum grade of D- and (MATH 1860 with a minimum grade of D- or MATH 1930 with a minimum grade of D-) and CHEM 1240 with a minimum grade of D-

Term Offered: Spring, Fall

BIOE 2300 Biomedical Quality Control

[3 credit hours]

Statistical methods for the design, testing and manufacturing of medical devices# the application of statistical methods to quality systems and process validation.

Prerequisites: (MATH 1860 with a minimum grade of D- or MATH 1930 with a minimum grade of D-)

Term Offered: Spring

BIOE 3110 Introduction To Biomechanics

[3 credit hours]

Mechanics of the human musculoskeletal system and its joints. Basic concepts for deformable body mechanics, including stress and strain analysis, viscoelasticity, and applications to common problems in orthopedic biomechanics.

Prerequisites: (CIVE 1150 with a minimum grade of D- and BIOL 2170 with a minimum grade of D-)

Term Offered: Spring

BIOE 3300 Biomedical Electronics

[3 credit hours]

Measurement circuits, signal analysis, and computer design in biological systems and medicine. Electronic devices, digital devices, amplifier design and instrumentation safety.

Prerequisites: (EECS 2300 with a minimum grade of D- and BIOE 1200 with a minimum grade of D-)

Term Offered: Spring, Fall

BIOE 3400 Biotransport Phenomena

[3 credit hours]

The quantitative description of momentum transport (viscous flow) and mass transport (convection and diffusion) in living systems. Application of engineering methods to model and quantify aspects of bioengineering systems.

Prerequisites: BIOE 2100 with a minimum grade of D- and MATH 2860 with a minimum grade of D- or MATH 3860 with a minimum grade of D- or MATH 3820 with a minimum grade of D-

Term Offered: Spring, Fall

BIOE 3500 Bioprocessing Laboratory

[0-3 credit hours]

Introduction to processing techniques used in biotechnology and pharmaceutical industries. The process from concept to product is covered, including the creation and culture of recombinant organisms to synthesize a protein product and the extraction, purification, and assay of the final product.

Prerequisites: (BIOL 2170 with a minimum grade of D- and BIOL 2180 with a minimum grade of D- and CHEM 1240 with a minimum grade of D-) and (MATH 1860 with a minimum grade of D- or MATH 1930 with a minimum grade of D-)

Term Offered: Spring, Fall

BIOE 3940 Co-Op Experience

[1 credit hour]

Approved co-op experience. Course may be repeated.

Prerequisites: BIOE 1010 with a minimum grade of D-

Term Offered: Spring, Summer, Fall

BIOE 3950 Co-Op Experience

[1 credit hour]

Approved co-op work experience beyond third required co-op experience. Course may be repeated.

Prerequisites: BIOE 3940 with a minimum grade of D-

Term Offered: Spring, Summer, Fall

BIOE 4100 Physiology For Bioengineers

[3 credit hours]

Review of general physiological principles followed by a comprehensive study of the human nervous, muscle, circulatory, respiratory, excretory and digestive systems from an engineering perspective.

Prerequisites: BIOL 2170 with a minimum grade of D- and BIOL 2180 with a minimum grade of D- and CHEM 1240 with a minimum grade of D- and EECS 2300 (may be taken concurrently) with a minimum grade of D-

Term Offered: Fall

BIOE 4110 Advanced Biomechanics

[3 credit hours]

The goal of this course is for students to be able to describe motions of the human body. Three-dimensional analysis and measurements of human body movements including kinematics, kinetics and energetics of human gait, anthropometry and application to bioengineering and orthopedics will be presented. Euler angles and the screw axis method will be used to describe three-dimensional motions.

Prerequisites: BIOE 3110 with a minimum grade of D-

Term Offered: Spring, Fall

BIOE 4120 Biosignal Processing

[3 credit hours]

Design and application of analog and digital signal processors to biomedical signals. Covered topics include the Laplace transform, analog filter design, continuous and discrete Fourier transform, and FIR/IIR digital filter design.

Prerequisites: BIOE 3300 with a minimum grade of D- and BIOE 4140 with a minimum grade of D- and (MATH 3860 with a minimum grade of D- or MATH 3820 with a minimum grade of D-)

Term Offered: Fall

BIOE 4140 Biomedical Instrumentation Laboratory

[0-2 credit hours]

Design and construction of medical instrumentation, including aspects of signal and image processing, computer integration, and software development. Written skills are emphasized through laboratory report organization, documentation of results, error analysis and interpretation of findings.

Prerequisites: BIOE 3300 (may be taken concurrently) with a minimum grade of D-

Term Offered: Spring, Fall

BIOE 4320 Advanced Biomedical Quality Control

[3 credit hours]

Advanced statistical methods for the design, testing and manufacturing of medical devices; the application of advanced statistical methods to quality systems and process validation.

Prerequisites: BIOE 4300 with a minimum grade of D-

Term Offered: Spring, Fall

BIOE 4410 Bioengineering Design Project I

[3 credit hours]

This course integrates the engineering and life science backgrounds of senior bioengineering students through the presentation of design principles for problems in biomechanical, bioelectrical, biochemical and biological systems. Oral and written communication, engineering economics and business plans are reviewed.

Prerequisites: MATH 2860 with a minimum grade of D- and EECS 2300 with a minimum grade of D- and CIVE 1150 with a minimum grade of D- and BIOE 3940 with a minimum grade of D- and BIOE 2100 with a minimum grade of D- and BIOE 2300 with a minimum grade of D- and BIOE 3500 with a minimum grade of D- and BIOE 2200 with a minimum grade of D- and BIOE 1200 with a minimum grade of D- and BIOE 1420 with a minimum grade of D-

Term Offered: Spring, Fall

BIOE 4420 Bioengineering Design Project II

[3 credit hours]

A continuation of BIOE 4410. Teams of senior bioengineering students solve problems in biomechanical, bioelectrical, biochemical and biological systems through a design project. Ethics discussions, testing and evaluation of designs, progress reports, oral presentations and a written final report are required.

Prerequisites: BIOE 3110 with a minimum grade of D- and BIOE 3400 with a minimum grade of D- and BIOE 3300 with a minimum grade of D- and BIOE 4140 with a minimum grade of D- and BIOE 4100 with a minimum grade of D-

Term Offered: Spring

BIOE 4610 Applications of Biotransport

[3 credit hours]

The application of engineering principles to the design and analysis of artificial organs, drug delivery systems, and tissue engineering and their clinical application.

Prerequisites: BIOE 3400 with a minimum grade of D-

Term Offered: Spring

BIOE 4620 Biochemical Engineering

[3 credit hours]

The application of engineering principles to the design and analysis of biological processes that employ living organisms for the production of biochemicals.

Prerequisites: BIOE 3500 with a minimum grade of D- and BIOE 3400 with a minimum grade of D-

Term Offered: Spring, Fall

BIOE 4630 Bioseparations

[3 credit hours]

Introduction to, analysis and industrial design of processes required to separate and purify proteins and other biological compounds for the downstream processing of bioreactor products. The separations techniques will include filtration, chromatography and crystallization.

Prerequisites: BIOE 3400 with a minimum grade of D- or CHEE 3120 with a minimum grade of D-

Term Offered: Fall

BIOE 4640 Medical Imaging

[3 credit hours]

Mathematics and physics underlying major medical imaging modalities including X-ray radiography and computerized tomography (CT), magnetic resonance imaging (MRI), nuclear medicine imaging, and ultrasound imaging.

Prerequisites: BIOE 4300 with a minimum grade of D- and MATH 2860 with a minimum grade of D- or MATH 3820 with a minimum grade of D- or MATH 3860 with a minimum grade of D- and PHYS 2140 with a minimum grade of D-

Term Offered: Fall

BIOE 4710 Biomechanics Of Soft And Hard Tissues

[3 credit hours]

Composite and hierarchical models bones; models of bone remodeling. Soft tissues models: linear and nonlinear viscoelasticity, Fung's quasilinear viscoelastic theory. Biphasic and triphasic models and mechano-ionic interactions.

Prerequisites: BIOE 3110 with a minimum grade of D-

Term Offered: Fall

BIOE 4720 Cellular Electrophysiology

[3 credit hours]

The physiology of electrically excitable tissues, including nerve, muscle and secretory tissues. Action potential generation, neurotransmission and modulatory mechanisms. Methods for constructing and using computational models of excitable membranes.

Prerequisites: (EECS 2300 with a minimum grade of D- and BIOE 4100 with a minimum grade of D-) and (MATH 2860 with a minimum grade of D- or MATH 3820 with a minimum grade of D- or MATH 3860 with a minimum grade of D-)

Term Offered: Spring

BIOE 4730 Computational Bioengineering

[3 credit hours]

Introduction to and utilization of computational packages for bioengineering applications. Introduction to finite element analysis and applications in biochemical, biofluidics, bioheat transfer, optimization.

Prerequisites: (BIOE 3110 with a minimum grade of D- and BIOE 1200 with a minimum grade of D-)

Term Offered: Spring

BIOE 4740 Tissue Engineering

[3 credit hours]

Application of principles from engineering and the life sciences toward the development of biological substitutes that restore, maintain or improve tissue function.

Prerequisites: (BIOE 2200 with a minimum grade of D- and BIOE 4100 with a minimum grade of D-)

Term Offered: Spring, Fall

BIOE 4750 Experimental Methods In Orthopedic Biomechanics

[3 credit hours]

This course provides students with experience in experimental techniques used in orthopaedics and in the study of the musculoskeletal system including mechanical testing of different materials, experimental and analytical methods for stress analysis, strain gages, methods used in human motion analysis to include motion capture, force pressure plates and electromyography. Students will learn to analyze human motion by capturing movements of their choice and will then conduct a biomechanical analysis to quantitatively describe their capture movements.

Prerequisites: BIOE 3110 with a minimum grade of D- or CIVE 1160 with a minimum grade of D-

Term Offered: Spring, Fall

BIOE 4830 Additive Manufacturing

[3 credit hours]

Additive manufacturing (AM) is a method of manufacturing that has been growing rapidly. In this course the students will learn about various AM technologies. They will also work with the required design software packages to create 3D models and 3D-print objects from the designed models.

Prerequisites: MIME 2650 (may be taken concurrently) with a minimum grade of D-

Term Offered: Spring, Fall

BIOE 4980 Bioengineering Special Topics

[1-3 credit hours]

Selected subjects in the field of bioengineering with intensive investigation of the recent literature in a few areas of special interest to the class and the professor.

Term Offered: Spring, Fall

BIOE 4990 Bioengineering Independent Study

[1-3 credit hours]

The student, under the guidance of their research adviser, explores in-depth specific areas or topics related to their research.

Term Offered: Spring, Summer, Fall