BIOMEDICAL ENGINEERING (BME)

BME 2101. Introduction to Biomedical Engineering. (3 Credits)
Fundamental concepts and techniques of engineering and medical science and their integration. The art and science of medicine and the process of medical diagnosis and treatment. Topics include: diagnostic instrumentation, diagnostic measurements and their interplay; bioelectric phenomena, biomechanics, and biomaterials; biochemical engineering; computers in medicine; molecular medicine and biotechnology; medical imaging.
Enrollment Requirements: MATH 1132Q, which may be taken concurrently; PHYS 1230 or 1501Q or 1530, each of which may be taken concurrently; open to non-BME majors with instructor consent. Recommended preparation: BIOL 1107.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%202101)

BME 2193. International Study. (1-6 Credits)
Special Biomedical Engineering topics taken in an international study program. May be repeated for up to six credits with change in topic. May count toward the major with consent of the adviser and approved plan of study.
May be repeated for a total of 6 credits
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%202193)

BME 3100. Physiological Modeling. (3 Credits)
Techniques for analysis and modeling of biomedical systems. Application of advanced mathematics (including Differential Equations, Laplace Transforms and Statistics) and computer-aided methods to study problems at the interface of engineering and biology. Elements of physiological modeling and the solution of the transient and forced response for a variety of biomechanical, biomaterial, bioelectrical and biochemical systems.
Enrollment Requirements: MATH 1132Q, which may be taken concurrently. Open only to Biomedical Engineering majors. Recommended preparation: BIOL 1107.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203100)

BME 3120. LabVIEW Basics for Engineers. (1 Credit)
Introduces LabVIEW programming environment. The fundamentals of using graphical programming to collect, analyze, display and store data are covered. Learn techniques for designing stand alone applications, creating interactive user interfaces and optimizing data flow.
Enrollment Requirements: CSE 1010 or 1100. Open only to Biomedical Engineering majors, others by instructor consent. Not open for credits to students who have passed ENGR 3120.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203120)

BME 3193. International Study. (1-6 Credits)
Special Biomedical Engineering topics taken in an international study program. May be repeated for up to six credits with change in topic. May count toward the major with consent of the adviser and approved plan of study.
May be repeated for a total of 6 credits
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203193)

BME 3320. Biosensors and Nanodevices for Biomedical Applications. (3 Credits)
Current and emerging technologies in biosensors for biomedical applications. Topics include principles of molecular and bio/chemical sensing, techniques for sensor integration, nano/micro electro mechanical systems (NEMS/MEMS) technologies used in biosensors, and commercial/clinical applications of biosensors.
Enrollment Requirements: Open only to BME majors, others by instructor consent. Not open for credit to students who have passed BME 4985 when taught as Biosensors and Nanodevices for Biomedical Applications.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203320)

BME 3400. Biosystem Analysis. (3 Credits)
A lecture course that covers Fourier analysis, Laplace analysis and Z-transforms. Techniques for generating quantitative mathematical models of physiological control systems; the behavior of physiological control systems using both time and frequency domain methods.
Enrollment Requirements: ECE 2001; open only to Biomedical Engineering majors, others by instructor consent. This course and ECE 3101 may not be both taken for credit.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203400)

BME 3401. Introduction to Computational and Systems Biology. (3 Credits)
Introduction to the role of computational and mathematical analyses in biological sequence (DNA, RNA, proteins) analysis and quantitative mathematical models of cell biological processes (systems and quantitative biology). Algorithms for sequence alignment, analysis of networks involved in transcription, development, and signal transduction. Programming in the Python language will be an integral part of the course, but no prior experience with Python is necessary.
Enrollment Requirements: MATH 2210Q, 2410Q; STAT 3025Q or 3345Q or MATH 3160.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203401)

BME 3420. Stem Cells for Regenerative Medicine. (3 Credits)
Introduces the fundamental concept and translational application of regenerative medicine such as stem cells, gene therapy, cell and tissue therapy. Topics include tissue-specific stem cells, embryonic stem cells, induced pluripotent stem cells and their potential therapeutic applications for musculoskeletal, cardiovascular and nervous systems.
Enrollment Requirements: Open only to BME majors, others with consent. Not open for credit to students who have passed BME 4985 when taught as Stem Cells for Regenerative Medicine.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203420)

BME 3500. Biomedical Engineering Measurements. (4 Credits)
A lecture and laboratory course that covers fundamentals of biomedical measurement and patient safety. Measurements of physical quantities by means of electronic instruments, mechanical devices and biochemical processes. Analysis of measurement systems using mathematical models. Methods of measuring signals in the presence of noise. Use of computers in measurement systems.
Enrollment Requirements: ECE 2001, open only to BME majors, others by instructor consent. Recommended preparation: BME 3120 and BME 3400 or ECE 3101.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203500)

BME 3520. Developing Mobile Apps for Healthcare. (3 Credits)
Mobile apps are changing the way doctors and patients approach health care. Designed for use by doctors, patients or both, the apps available range from handy databases about drugs and diseases to sophisticated monitors that read a person's physiological signals. Students will learn the basic elements of apps development on Android platforms, including XML, and Java, UI amongst others. Topics include how to handle patient data in the cloud using HIPAA-Compliant web service and how to integrate machine learning models in app development. No previous programming experience is needed.
Enrollment Requirements: Open only to BME majors, others with consent. Not open for credit to students who have passed BME 4985 when taught as Developing Mobile Apps for Healthcare.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203520)

BME 3540. Principles of Biomedical Optical Sensing: A Laboratory-Based Course. (3 Credits)
Undergraduate laboratory course that covers the fundamental optical sensing principles of devices used in medicine and research. Topics include laser beam manipulation and forming, optical fibers and photodetectors, polarizers and polarimetry, molecular sensing, pressure mapping via FTIR, blood oxygen concentration (Pulse Oximetry), interferometric-based imaging systems and photo spectrometry. The course is designed for students' who seek to acquire skills in handling and working with optical components.
Enrollment Requirements: PHYS 1501Q and 1502Q, open only to Biomedical Engineering majors, others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203540)

BME 3600. Biomechanics. (4 Credits)
Application of solid mechanics theory to describe and analyze mechanical behaviors of biological tissues. Basic concepts in mechanics of materials, including the essential mathematics, kinematics of deformation and motion, stress, constitutive relations. Biomechanics principles; identifying, formulating and solving problems related to bone, cartilage, tendon, cardiac and vascular tissues. Introduction of experimental methods and computational modeling of biological tissues. A separate laboratory component will introduce students to experimental methods in more detail. Laboratory reports with revisions are required.
Enrollment Requirements: BME 3150 or CE 2110; open only to Biomedical Engineering majors; others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203600)

BME 3620. Failure Analysis for Biomedical Application. (3 Credits)
Study and analysis of the causes of material and device failures as it relates to biomedical engineering. Types of material failures and failure mechanisms. Discussion of appropriate material selection, design and application as it relates to mitigating failure risk. Case studies of historical material failures in biomedical engineering.
Enrollment Requirements: MSE 2001 or 2101; open only to Biomedical Engineering majors, others by instructor consent. Not open for credit to students who have passed BME 4985 when offered as Failure Analysis for Biomedical Application.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203620)

BME 3630. Multiphysics Finite Element Analysis. (3 Credits)
The course material emphasizes basic mathematical and physical principles underlying finite element analysis (FEA), general procedure of identifying and solving engineering problems using COMSOL Multiphysics FEA software, and interpretation of FEA results.
Enrollment Requirements: MATH 1132Q and 2410Q, or by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203630)

BME 3640. Human Factors Engineering. (3 Credits)
This course introduces students to the field of human factors engineering. Topics include user-centered design and the different tools available to anticipate and solve human-use issues.
Enrollment Requirements: Open only to Biomedical Engineering majors, others by instructor consent. Not open for credit to students who have passed BME 4985 when offered as Human Factors Engineering.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203640)

BME 3700. Biomaterials. (4 Credits)
A lecture and laboratory course that introduces a series of implant materials including metals, ceramics, glass ceramics, polymers, and composites. These materials are compared with the natural materials, with consideration given to issues of mechanical properties, biocompatibility, degradation of materials by biological systems, and biological response to artificial materials. Particular attention is given to the materials for the total hip prosthesis, dental restoration, and implantable medical devices.
Enrollment Requirements: MSE 2101 and MATH 2410; open only to BME majors. Cannot be taken for credit after passing MSE 3700.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203700)

BME 3720. Drug Delivery. (3 Credits)
Introduction to drug delivery systems that provide pharmaceutical agents at target tissues, the mechanism of pharmacokinetic regulation, the basics, technology, and applications of drug delivery systems. Emphasis on understanding the principles of pharmacokinetics and drug delivery systems to improve clinical efficacy as well as to reduce side effects.
Enrollment Requirements: BME 3700; open only to BME majors, others with consent. Not open for credit to students who have passed BME 4985 when taught as Drug Delivery.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203720)

BME 3740. Introduction to Microscopy and Biophotonics. (3 Credits)
Basic principles of modern light microscopy and related biophotonics techniques. Matlab will be used to model various imaging platforms. Topics include geometrical optics; image processing in spatial and Fourier domain; lensless microscopy imaging; light scattering and absorption in tissue; wave propagation; coherent and incoherent imaging; lens-based imaging systems; optical aberrations; phase retrieval; brightfield, darkfield, phase-contrast, and confocal microscopy; holographic imaging; light field microscopy; 3D tomographic imaging; autofocusing for whole slide imaging; two-photon imaging; structured illumination and other super-resolution techniques; Fourier ptychographic imaging; detectors and photon transfer curve; image denoising via regularization; optical coherent tomography.
Enrollment Requirements: BME 3400 or ECE 3101; open only to Biomedical Engineering majors, others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203740)

BME 3750. Tissue Engineering Laboratory. (3 Credits)
This is an undergraduate laboratory course designed to provide hands on training in tissue engineering methods and techniques. Students will learn the necessary skills required for culturing and maintaining cells to practice tissue engineering strategies. The students will also learn basic tissue engineering lab techniques and develop assays and staining methods related to the development and evaluation of in vitro tissue engineering products.
Enrollment Requirements: Open only to Biomedical Engineering majors, others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203750)

BME 3760. Microfluidics and Lab-on-Chip. (3 Credits)
The course provides a broad overview of microfluidics technology, lab-on-chip, wearable/implantable devices and smartphone-based optical sensing technology, and their biomedical applications. It also covers the fundamentals of micro/nano fabrication technologies and additive manufacturing (e.g., 3D printing). In addition, the basic principles of biology and chemistry, with a focus on how to integrate them into microfluidic devices and biomedical microsystems are introduced and discussed.
Enrollment Requirements: Open only to Biomedical Engineering majors, others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203760)

BME 3780. Introduction to Biomanufacturing: Pharmaceutical Proteins. (3 Credits)
This course provides an overview of the large scale bioprocessing and biomanufacturing of biopharmaceutical products (biologics). Topics include conventional versus biologic drug manufacturing, key phases in the process of drug manufacturing (bench to bottle), upstream and downstream operations, bioreactor design, purification process, safety and efficiency of biologics, quality assurance, regulation and introduction to Good Manufacturing Practices (GMP) in bio-manufacturing.
Enrollment Requirements: Open only to Biomedical Engineering majors, others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203780)

BME 3810. Computational Genomics. (3 Credits)
(Also offered as CSE 3810.) Computational methods for genomic data analysis. Topics covered include statistical modeling of biological sequences, probabilistic models of DNA and protein evolution, expectation maximization and Gibbs sampling algorithms, genomic sequence variation, and applications in genomics and genetic epidemiology.
Enrollment Requirements: BIOL 1107; CSE 1729 or CSE 2050; STAT 3025Q or 3345Q or 3375Q or MATH 3160; open only to students in the School of Engineering and declared Computer Science minors.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203810)

BME 3900. Junior Design. (3 Credits)
Students work through a structured process that emulates an open-ended, real-world design of a biomedical engineering product. Project definition and product specifications, project scheduling and management, team interactions, failure and safety criteria, progress reporting, marketing concepts, ethical issues, prototype development, proper documentation and technical presentation of the final project outcomes. Includes a significant writing component, makes use of computers and design software, and involves hands-on design explorations. Students will complete a semester-long design project that demonstrates the skills and knowledge learned during the course in preparation for the capstone design experience.
Enrollment Requirements: BME 3500 and 3600; or CE 2110, ECE 2001, and MSE 2101.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%203900)

BME 4120. Neural Information Processing and Sensory Coding. (3 Credits)
Processing, transmission, and storage of information in the central and peripheral nervous systems. Mechanisms of signal generation, transmission and coding by neurons and dendrites. Analysis of invertebrate and vertebrate visual and auditory systems, including: mechanisms of neurosensory transduction, coding, and signal-to-noise ratio enhancement. Neural spatio-temporal filters for feature extraction and pattern recognition. Information theoretic analysis of signal encoding and transmission in the nervous system. Assumes a background in linear systems and feedback control systems.
Enrollment Requirements: BME 3400 or ECE 3101; open only to Biomedical Engineering majors, others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204120)

BME 4130. Neural Prostheses. (3 Credits)
Development of neural prostheses. Topics will cover physiology of neurological disorders, key concepts of neural prostheses, electrode designs and materials, fabrication methodologies, measurement techniques, histological evaluations, and clinical translations. Students will also learn to critique journal articles and to write their own NIH research proposal.
Enrollment Requirements: Open only to Biomedical Engineering majors, others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204130)

BME 4170. Nanomedicine: From Concepts to Applications. (3 Credits)
Teaches students competency and practical skills in applying nanotechnology to solve problems in medicine. Upon completion of the course, the students will be able to understand the basic concept of Nanomedicine and have an overview of the Nanomedicine field; understand principles and experimental methods in designing, generating, charactering and evaluating nanotechnology-enabled therapeutics; understand how Nanomedicine is translated from scientific innovation to clinical applications; understand how Nanomedicine is applied in the cutting-edge breakthroughs of biotechnology and medicine; develop critical thinking and independent learning skills; and design a successful Nanomedicine project.
Enrollment Requirements: Open only to Biomedical Engineering majors, others by instructor consent. Not open for credit to students who have passed BME 4985 when taught as Nanomedicine: From Concepts to Applications.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204170)

BME 4201. Introduction to Medical Imaging. (3 Credits)
Introduction to spatial signals including spatial impulse response, spatial sampling and filtering, spatial Fourier transforms, and back projection. Principles, systems and clinical applications of X-ray, X-ray CT, ultrasound, Positron Emission Tomography (PET) and Single Photon Emission Tomography (SPECT), and MRI imaging.
Enrollment Requirements: PHYS 1502Q; BME 3500, and BME 3400 or ECE 3101; open only to Biomedical Engineering majors, others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204201)

BME 4300. Physiological Control Systems. (3 Credits)
Analysis of human physiological control systems and regulators through the use of mathematical models. Identification and linearization of system components. Systems interactions, stability, noise, and the relation of system malfunction to disease. The analysis and design of feedback systems to control physiological states through the automatic administration of drugs.
Enrollment Requirements: BME 3400 or ECE 3101; open only to BME majors.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204300)

BME 4410. Systems Biology of Cells and Tissues. (3 Credits)
The course will present a broad systems level overview of how cells and tissues interact with each other at different physical scales to create complex physiological outcomes. In addition, it will cover a variety of techniques and experimental models in biology, as well as introduce examples to observe cells and tissues at multiple scales.
Enrollment Requirements: Open only to BME majors, others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204410)

BME 4500. Bioinstrumentation. (3 Credits)
Modeling, analysis, design, and operation of transducers, sensors, and electrodes, for physiological systems; operational and instrumentation amplifiers for bioelectric event signal conditioning, interfacing and processing; A/D converters and hardware and software principles as related to sampling, storing, processing, and display of biosignals and digital computers.
Enrollment Requirements: BME 3500; BME 3400 (or ECE3101); open only to Biomedical Engineering majors, others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204500)

BME 4560. Biomedical Signal Processing Laboratory. (3 Credits)
This course provides students the opportunity to develop skills to use computational methods in time- and frequency domains to analyze some of most commonly used biomedical signals such as ECG, photoplethysmogram (PPG), electromyogram (EMG), and electrodermal activity (EDA). All data analyses are performed using Matlab software.
Enrollment Requirements: BME 3100, 3500, and BME 4500; Open only to Biomedical Engineering majors, others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204560)

BME 4701. Biomedical Materials and Implants. (3 Credits)
This advanced course will enable students to further expand their knowledge in various aspects of biomaterials science, engineering and applications. The course will focus on the strategies to improve cell-material and tissue-implant interaction. An emphasis is placed on the biomaterial innovations and technologies that integrate bioactivity, functionality to improve the performance of the implants. The course will also provide an overview of the FDA regulatory pathways for biomaterial and implant approvals.
Enrollment Requirements: BME 3700; open only to BME majors. Not open to students who have passed MSE 4701.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204701)

BME 4710. Tissue Engineering. (3 Credits)
Presents basic principles of biological, medical, and material science as applied to implantable medical devices, drug delivery systems and artificial organs.
Enrollment Requirements: BME 3700; open only to BME majors.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204710)

BME 4720. Cellular Engineering. (3 Credits)
Cellular engineering emphasizes the navigation and understanding of discoveries in stem cell, molecular, and developmental biology from an engineering perspective. Student projects and an active learning approach enable students to practice the complex and open-ended process of synthesizing and translating basic discoveries for the rational design of tissue regeneration therapies.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204720)

BME 4730. Biomicrofluidics, Biofabrication, and Biomanufacturing. (3 Credits)
This course is an introduction to the fundamentals of micro- and nanofabrication processes. In addition, transport phenomena in microfluidic systems, bioprinting and additive manufacturing technologies are discussed. Topics covered during the semester include microfabrication, non-conventional microfabrication, microfluidics, transport phenomena in miniaturized systems, microfluidic assisted manufacturing, bioprinting, biofabrication and organs-on-a-chip.
Enrollment Requirements: Open only to Biomedical Engineering majors, others by instructor consent. Not open for credit to students who have passed BME 4985 when offered as Biomicrofluidics, Biofabrication, and Biomanufacturing.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204730)

BME 4800. Bioinformatics. (3 Credits)
(Also offered as CSE 3800.) Fundamental mathematical models and computational techniques in bioinformatics. Exact and approximate string matching, suffix trees, pairwise and multiple sequence alignment, Markov chains and hidden Markov models. Applications to sequence analysis, gene finding, database search, phylogenetic tree reconstruction.
Enrollment Requirements: BIOL 1107; CSE 1729 or CSE 2050; STAT 3025Q or 3345Q or 3375Q or MATH 3160; open only to students in the School of Engineering and declared Computer Science minors, others by instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204800)

BME 4810. Machine Learning Methods for Biomedical Signal Analysis. (3 Credits)
The objective of this course is to learn the basic machine learning concepts and tools that are required in modern biomedical engineering to model, analyze, and classify physiological time series. Specific focus is on multivariate data and time series extracted from multiple physiological sources, including (but not limited to) ECG, EEG, and EMG. Through a mix of lectures and hands-on laboratory experiences, the students will learn how to design and implement a machine learning project, how to use advanced statistical tools and methods to classify data, infer predictions, and validate data-driven predictive models.
Enrollment Requirements: CSE 1010 and STAT 3025Q; open only to Biomedical Engineering majors, others by instructor consent. Not open for credit to students who have passed BME 4985 when taught as Advanced Methods for Biomedical Signal.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204810)

BME 4900. Biomedical Engineering Design I. (3 Credits)
Discussion of the design process; project statement, specifications project planning, scheduling and division of responsibility, ethics in engineering design, safety, environmental considerations, economic constraints, liability, manufacturing, and marketing. Projects are carried out using a team-based approach. Selection and analysis of a design project to be undertaken in BME 4910 is carried out. Written progress reports, a proposal, an interim project report, a final report, and oral presentations are required.
Enrollment Requirements: Open only to Biomedical Engineering majors; prerequisites vary by track as follows: Biomaterials and Tissue Engineering, BME 3500, 3600, 3700, and 3900; Biomechanics and Mechanobiology, BME 3600 and 3900; Computational and Systems Biology, BME 3900; Systems, Imaging and Instrumentation, BME 3500 and 3900; no track: BME 3500, 3600, and 3700.
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204900)

BME 4910W. Biomedical Engineering Design II. (3 Credits)
Design of a device, circuit system, process, or algorithm. Team solution to an engineering design problem as formulated in BME 4900, from first concepts through evaluation and documentation. Written progress reports, a final report, and oral presentation are required.
Enrollment Requirements: BME 4900; ENGL 1007 or 1010 or 1011 or 2011; open only to Biomedical Engineering majors.
Skill Codes: COMP. Writing Competency
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204910W)

BME 4985. Special Topics in Biomedical Engineering. (1-6 Credits)
Classroom and/or laboratory courses in special topics as announced for each semester. With a change of topic, this course may be repeated for credit.
Enrollment Requirements: Open only to BME majors. Prerequisites and/or consent announced separately for each topic.
May be repeated for credit
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204985)

BME 4999. Independent Study. (1-6 Credits)
Independent study project carried on by the student under the guidance of a faculty member. The student is required to submit a report on the study at the end of the semester. With a change in content, this course may be repeated for credit.
Enrollment Requirements: Open only to Biomedical Engineering majors. May be repeated for credit
View Classes (https://catalog.uconn.edu/course-search/?details&code=BME%204999)