BIOMEDICAL ENGINEERING (BME)

Explanation of Course Numbers

- Courses in the 1000s are primarily introductory undergraduate courses
- Those in the 2000–4000s are upper-division undergraduate courses that can also be taken for graduate credit with permission and additional work
- Those in the 6000s and 8000s are for master's, doctoral, and professional-level students
- The 6000s are open to advanced undergraduate students with approval of the instructor and the dean or advising office

BME 1010. Introduction to Biomedical Engineering. 1 Credit.
Basic and emerging concepts in electrical, computer, and biomedical engineering. Hands-on experiments and projects. Introduction to the professional literature and available resources and to technical writing, speaking, and presentation skills.   (Fall).

BME 1020. Introduction to Biomedical Engineering. 2 Credits.
Continuation of BME 1010. Basic and emerging concepts in electrical, computer, and biomedical engineering; practical experiments and projects; introduction to the professional literature and available resources and to technical writing, speaking, and presentation skills. Prerequisite: BME 1010.   (Spring, Every Year).

BME 2810. Biomedical Engineering Seminar I. 1 Credit.
BME 2810 and BME 2815 are taken in sequence by students in the biomedical engineering major. Overview of the field of biomedical engineering, including biomechanics, bioinformatics, telemedicine, instrumentation, and medical imaging. Prerequisite: BME 1020. (Fall).

BME 2815. Biomedical Engineering Seminar II. 1 Credit.
BME 2810 and BME 2815 are taken in sequence by students in the biomedical engineering major. Overview of the field of biomedical engineering, including biomechanics, bioinformatics, telemedicine, instrumentation, and medical imaging.   (Fall and spring).

BME 2820. Biomedical Engineering Programming I. 3 Credits.
Introduction to Matlab Programming and fundamentals of programming in general with a focus on biomedical engineering problems. Functions, input/output, selection statements, loop statements, string manipulation, and debugging techniques will be covered; manipulation of vectors and matrices and the use of vectorized code. (Fall).

BME 2825. Biomedical Engineering Programming II. 3 Credits.
Introduction to C Programming and fundamentals of data structures with a focus on biomedical engineering problems; the use of data structures, pointers, and linked lists and discuss concepts such as binary trees and sorting algorithms. Students are expected to understand the basics of programming concepts such as the use of functions, input/output, selection statements, loop statements, string manipulation, and debugging techniques are understood, but no prior knowledge of C is required. Prerequisite: BME 2820; equivalent course may be substituted at instructor's discretion. (Fall).

BME 3820. Principles and Practice of Biomedical Engineering. 4 Credits.
Introduction to engineering principles applicable to medicine; medical measurements for clinical use and research; anatomy and physiology of the human body from system and cellular approaches. Principles of biomedical engineering are reinforced by determining and analyzing physiological measurements in laboratory exercises. Prerequisites: ECE 2110 and APSC 2113. (Fall).

BME 3907. Special Topics in Biomechanical Engineering. 3 Credits.
Topics vary by semester. May be repeated for credit if topic differs. See the Schedule of Classes for more details.   (Fall, spring, and summer).

BME 3910. Capstone Design Preparation. 1 Credit.
Elements of project design; formulation of project ideas. Prerequisites: BME 2810, BME 2815. (Same as ECE 3910) (Fall).

BME 3915W. Biomedical Engineering Capstone Project Lab I. 1 Credit.
BME 3915, BME 4920, and BME 4925 are taken in sequence by departmental majors beginning in the second semester of the junior year. After an introduction to the formal design process, the student plans, refines, designs, and constructs a one-year project. Prerequisite: BME 3910. (Same as ECE 3915W) (Spring).

BME 4820. Anatomy and Physiology for Engineers. 3 Credits.
Human anatomy and physiology from an engineering viewpoint. Analysis of functions of major physiological systems. Biopotentials, mechanics, gas exchange, chemical balance, electrical and chemical signaling, nervous control, voluntary and reflex factors. (Same as BME 6820) (Fall).

BME 4825. Biomedical Properties Laboratory. 1 Credit.
Introduction to biophysical concepts in a laboratory setting; emphasis on biomedical engineering. (Spring).

BME 4830. Introduction to Medical Imaging Methods. 3 Credits.
Common imaging modalities, including ultrasound, X-ray, MRI, CT, SPECT, and PET. Overview of linear systems, basic properties of an imaging system, the physics and instrumentation behind each modality, and their respective advantages, disadvantages, and applications. May be taken for graduate credit. Prerequisites: ECE 3220, BME 3820.   (Spring).

BME 4920W. Biomedical Engineering Capstone Project Lab II. 3 Credits.
BME 3915, BME 4920, and BME 4925 are taken in sequence by departmental majors beginning in the second semester of the junior year. After an introduction to the formal design process, the student plans, refines, designs, and constructs a one-year project. Includes a significant engagement in writing as a form of critical inquiry and scholarly expression to satisfy the WID requirement. Prerequisite: BME 3915W. (Same as ECE 4920W)   (Fall, Every Year).

BME 4925W. Biomedical Engineering Capstone Project Lab III. 3 Credits.
BME 3915, BME 4920, and BME 4925 are taken in sequence by departmental majors beginning in the second semester of the junior year. After an introduction to the formal design process, the student plans, refines, designs, and constructs a one-year project. Includes a significant engagement in writing as a form of critical inquiry and scholarly expression to satisfy the WID requirement.   (Spring, Every Year).

BME 4990. Research. 1-3 Credits.
Applied research and experimentation projects, as arranged. Prerequisites: junior or senior status.   (Fall and spring).

BME 6045. Special Topics. 1-3 Credits.
Topics to be announced in the Schedule of Classes.   (Fall and spring).

BME 6050. Research. 1-12 Credits.
Applied research and experimentation projects, as arranged. May be repeated for credit.

BME 6065. Colloquium. 0 Credits.
Lectures by outstanding authorities in biomedical engineering. Topics to be announced each semester.   (Fall and spring).

BME 6481. Regulatory Law for Medical Devices. 3 Credits.
An introduction to legal issues pertinent to medical device regulation; device classification, general and special controls, quality system regulation, 510(k) submissions, premarket approval applications (PMAs), clinical trials, investigational device exemptions (IDEs) and medical device reporting (MDR), recalls, labeling and advertising, enforcement, and emerging legal issues. Pharmaceutical regulation. (Fall).

BME 6482. Medical Measurements. 3 Credits.
Theory of measurements in biological areas and techniques for electronic measurements on biological specimens. Experiments in acquisition, processing, and measurement of physiological signals, ECG, EEG, and EMG. (Fall).

BME 6483. Medical Instrumentation Design. 3 Credits.
The medical device design process and many of its key aspects, including needs assessment, regulatory processes and concerns, intellectual property, patient safety, and market analysis. Prerequisites: BME 6482.   (Spring).

BME 6484. Biomedical Signal Analysis. 3 Credits.
Origin, acquisition, and analysis of physiological signals. Deterministic and probabilistic modeling; fitting models; sequences and time series. Feature extraction from EEG and ECG; Fourier analysis and filtering; modeling. Noise and artifact removal and signal compensation. Prerequisites: BME 6482.   (Spring).

BME 6485. Medical Imaging I. 3 Credits.
Principles of projection radiography, fluoroscopy, tomography, ultrasound and nuclear sources; biomagnetic imaging. Source and object; recorder resolution and noise; scatter and attenuation. Ultrasound techniques and instrumentation, including physics of ultrasound, transducers, ultrasound imaging, hemodynamics, Doppler techniques. Prerequisite: BME 4830. (Fall).

BME 6486. Clinical Medicine for Engineers. 3 Credits.
Overview of clinical medicine with emphasis on those areas most affected by engineering and technology. Prerequisites: BME 6482.   (Spring, even years).

BME 6487. Rehabilitation Medicine Engineering. 3 Credits.
Cross-sectional view of those areas of medicine most involved with the treatment of handicapped individuals; application of engineering theory and techniques to the rehabilitation of handicapped individuals; solutions to major problem areas and specific problems. Prerequisite: BME 6482. (Spring, Every Year).

BME 6820. Anatomy and Physiology for Engineers. 3 Credits.
Human anatomy and physiology from an engineering perspective. Analysis of functions of major physiological systems. Biopotentials, mechanics, gas exchange, chemical balance, electrical and chemical signaling, nervous control, voluntary and reflex factors. (Same as BME 4820) (Fall).

BME 6840. Digital Image Processing. 3 Credits.
Properties of images and visual systems. Image acquisition, sampling, quantization. One- and two-dimensional image transform techniques; enhancement and restoration. Image coding and data compression. Segmentation, representation, boundary and shape, texture, matching. Image understanding. Prerequisites: ECE 6800. (Same as ECE 6840) (Spring, odd years).

BME 6842. Image Engineering. 3 Credits.
Sensor/camera design and analysis as a system. Detection and noise processes underlying the sensing of optical radiation; the engineering and physics of image formation. Topics covered include radiometry/photometry, optics and image formation, device and camera characterization, and image quality metrics and system design trades. Prerequisites: ECE 6010, ECE 6015. (Same as ECE 6842) (Fall, Every Year).

BME 6850. Pattern Recognition. 3 Credits.
Random vectors, transformations. Hypothesis testing, error probability: bias, variance, and sample size, resampling; sequential methods. Bayes, other linear classifiers. Discriminant functions, support vector machines, maximum-likelihood and parameter estimation, dimensionality reduction. Nonparametric methods; unsupervised learning and clustering; feature selection and ordering. Applications in industry and medicine. Student projects. Learning is reinforced by homework problems and in-class and at-home computer examples. Prerequisite: ECE 6015. (Same as ECE 6850) (Fall, Spring, and Summer, Every Year).

BME 6885. Computer Vision. 3 Credits.
Image processing; edge detection, segmentation, local features, shape and region description in 2D and 3D. Insights from human vision studies. Representation for vision: object models, synthetic images, matching, gaps, algorithms. Interference, production system, syntactic networks. Planning spatial reasoning for robot vision. Prerequisites: BME 6840 or ECE 6840 or equivalent. (Same as ECE 6885) (Fall, Spring, and Summer, Every Year).

BME 6994. Biomedical Engineering Regulatory Practicum I. 3 Credits.
First part of the BME 6994-BME 6995 practicum sequence. Students work with a practicum mentor to develop either an application for federal funding using the Small Business Innovation Research (SBIR) or Small Business Technology Transfer (STTR) mechanism or a 510(k) submission for U.S. Food and Drug Administration (FDA) medical device review. Independent research combined with the synthesis of technical and regulatory topics covered in the program. Restricted to students who have completed a minimum of 9 credits in the Master of Engineering in Regulatory Biomedical Engineering program.   (Fall, spring, and summer).

BME 6995. Biomedical Engineering Regulatory Practicum II. 3 Credits.
Second part of the BME 6994-BME 6995 practicum sequence. Prerequisites: BME 6994.   (Fall, spring, and summer).

BME 6998. Thesis Research. 3 Credits.
Thesis research.   (Fall and spring).

BME 6999. Thesis Research. 3 Credits.
Thesis research.   (Fall and spring).

BME 8484. Medical Imaging II: Image Analysis. 3 Credits.
Review of medical imaging modalities; review of image formation and characteristics, both static and dynamic; methods for and evaluation of: medical image reconstruction, enhancement, segmentation, registration, and description; feature extraction and classification; error analysis and the receiver operating characteristic; imaging applications in diagnosis and treatment, including surgery; metrics of truth and quality, with implications for image compression. Prerequisites: BME 6484.   (Fall).

BME 8999. Dissertation Research. 0-12 Credits.
Limited to Doctor of Philosophy candidates. May be repeated for credit.   (Fall, spring, and summer).