BIOMEDICAL ENGINEERING

BME 5052L Biomedical Engineering Laboratory 3 Credits
Grading Scheme: Letter Grade
Integrates state-of-the-art technologies with a hands-on approach to education in a flexible system of academic topics tailored for specific disciplines within biomedical engineering, by teaching primary laboratory skills, experimental design, interpretation of data, and technical writing relevant to laboratory work.

BME 5085 Patents, Product Development, and Technology Transfer 2 Credits
Grading Scheme: Letter Grade
For engineers and scientists. Product discovery and development; patents and trade secrets; copyright and trademark law; international intellectual property considerations; regulatory issues; business planning and market research; and licensing, marketing, negotiation, and technology transfer.

BME 5401 Biomedical Engineering and Physiology I 3 Credits
Grading Scheme: Letter Grade
Physiology of cells, bones, and the circulatory system from a biomaterials, biomechanics, cellular, and tissue engineering perspective. Intellectual property and technology transfer included.

BME 5407 Molecular Biomedical Engineering 3 Credits
Grading Scheme: Letter Grade
Fundamentals of molecular biology for biomedical engineers.

BME 5500 Biomedical Instrumentation 3 Credits
Grading Scheme: Letter Grade
Engineering and medical aspects of measuring and processing signals from living systems. Discusses biomedical transducers for measuring movement, biopotentials, pressure, flow, concentrations, and temperature; and treatment devices like ventilators and infusion pumps. Whenever possible, devices actually used in clinical practice are used in class.
Prerequisite: basic knowledge of physics and calculus, consent of instructor.

BME 5703 Statistical Methods for Biomedical Engineering 3 Credits
Grading Scheme: Letter Grade
Computational methods needed for biomedical engineering research. Students will be acquainted with a variety of techniques for analyzing and modeling experimental data arising in molecular, cellular, physiological, and pathological systems encountered in typical laboratory and clinical settings.
Prerequisite: Knowledge of calculus, linear algebra and basic statistics.

BME 5704 Advanced Computational Methods for Biomedical Engineering 3 Credits
Grading Scheme: Letter Grade
Covering advanced computational methods from a biomedical engineering perspective. Linear and nonlinear systems, partial differential equations, optimization and inverse problems will be discussed. This course is geared towards the applications of the advanced computational techniques to various biomedical engineering problems.
Prerequisite: A basic knowledge of physics and calculus is required. This can be met by PHY2053 and MAC2311.

BME 5743 Applied Data Mathematics 3 Credits
Grading Scheme: Letter Grade
Advanced data science technology with Matlab to analyze biomedical data.
Prerequisite: COP 2271 or equivalent & BME 3053L or equivalent.

BME 5937 Special Topics 1-4 Credits, Max 6 Credits
Grading Scheme: Letter Grade
Special Topics

BME 6010 Clinical Immersion 1 Credit, Max 6 Credits
Grading Scheme: Letter Grade
Biomedical engineers develop practical solutions to various problems encountered in healthcare and clinical practice. Students learn and identify such problems through direct immersion in the clinical environment. Students will shadow a clinician (one-on-one) for 1-3 hours per week where they will identify a clinical problem and propose a solution.
Prerequisite: BME 6018 Clinical Correlations.

BME 6018 Clinical Correlations in BME 3 Credits
Grading Scheme: Letter Grade
Biomedical engineers develop practical solutions to various problems encountered in healthcare and clinical practice. Students are exposed to clinical problems, learn how to identify unmet needs and will devise engineering solutions to address clinical needs. Topics related to clinical translation of biomedical innovations and medical device commercialization will be covered.
Prerequisite: BME 5401.

BME 6164 Magnetic Biomaterials 3 Credits
Grading Scheme: Letter Grade
Consists of classroom lectures on fundamental concepts in magnetism and magnetic micro- and nano-materials and their applications in biomedicine. As part of the course, students will present a critical review of recent literature in the field and lead a group discussion on a specific recent paper.
Prerequisite: Undergraduate physics and chemistry

BME 6324 Stem Cell Engineering 3 Credits
Grading Scheme: Letter Grade
Including an historical review of stem cell research and policies surrounding stem cell research, current stem cell sources, strategies and reviews of current stem cell research. This information is essential for Biomedical Engineers to understand in repairing/rebuilding the human body after injury or disease using stem/progenitor cell strategies.
Corequisite: Undergraduate cell biology and molecular biology and physiology, or enrollment in the Biomedical Engineering graduate program, or consent from instructor.

BME 6330 Cell and Tissue Engineering 3 Credits
Grading Scheme: Letter Grade
Applying engineering principles, combined with molecular cell biology, to developing a fundamental understanding of property-function relationships in cells and tissues. Exploiting this understanding to manipulate cell and tissue properties rationally to alter, restore, maintain, or improve cell and tissue functions; and to design bioartificial tissue substitutes.
Prerequisite: GMS 6421, BME 5001, or consent of instructor.

BME 6360 Neural Engineering 3 Credits
Grading Scheme: Letter Grade
Applying engineering to neuroscience including such diverse areas as neural tissue engineering, models of neural function, and neural interface technology. Focuses mainly in the context of neural interfaces and prosthetics, from basic neural physiology and models of neural mechanisms to advanced neural interfaces currently in development or produced commercially.
Prerequisite: consent of instructor.
BME 6502 Introduction to Medical Imaging 3 Credits
Grading Scheme: Letter Grade
Modern medical imaging technologies from a biomedical engineering perspective. The physics, mathematics, instrumentation and clinical applications of all common medical imaging modalities including x-ray radiography, computed tomography (CT), ultrasound imaging, positron emission tomography (PET), and magnetic resonance imaging (MRI) with a focus on non-ionizing radiation will be discussed. Emerging imaging modalities including diffuse optical tomography (DOT), Fluorescence Molecular Tomography (FMT), and photoacoustic tomography (PAT) will also be introduced.

BME 6522 Biomedical Multivariate Signal Processing 3 Credits
Grading Scheme: Letter Grade
Statistical analysis of biomedical signals, emphasizing multivariate time series. Introduces analysis concepts and methods in the time domain and the spectral domain. Uses actual recordings from biomedical applications to demonstrate the methods.
Prerequisite: multivariate calculus and a basic knowledge of probability and statistics.

BME 6534 Advanced Therapeutic Radiological Physics 3 Credits
Grading Scheme: Letter Grade
Advanced course in therapeutic radiation therapy physics covering special topics targeted to those pursuing careers in radiation therapy physics.
Prerequisite: ENU 6627: Therapeutic Radiological Physics

BME 6535 Radiological Physics, Measurements and Dosimetry 3 Credits
Grading Scheme: Letter Grade
Interacting and measuring techniques for x-rays, gamma rays, neutrons and charged particles with matter; radioactive decay processes ion chamber measurements, scintillation detectors, and dosimetry techniques. Applications of cavity theory and dosimetry measurement in medical physics.
Prerequisite: Upper level college physics

BME 6592 Therapeutic Radiological Physics II 3 Credits
Grading Scheme: Letter Grade
Building upon the basic principles of radiation therapy studying more advanced radiation treatment planning, electron beam and brachytherapy techniques. Topics of clinical and regulatory significance including radiation shielding and quality assurance.
Prerequisite: BME 6591 (Therapeutic Radiological Physics I) or permission of instructor.

BME 6593 Therapeutic Radiological Physics III 3 Credits
Grading Scheme: Letter Grade
Exploring state-of-the-art radiation therapy techniques in clinical practice. Examining the physical principles and clinical implementation of three-dimensional conformal therapy, intensity modulated radiation therapy, stereotactic radiosurgery, high dose rate brachytherapy, image guided radiation therapy, proton beam therapy, and other techniques as they become integrated into clinical practice.
Prerequisite: BME 6592 (Therapeutic Radiological Physics II) or permission of instructor.

BME 6705 Mathematical Modeling of Biological and Physiological Systems 3 Credits
Grading Scheme: Letter Grade
Mathematical modeling of biological and physiological phenomena. Starting from basic theory of linear systems, introduces qualitative analysis of nonlinear ordinary differential equations and maps. Examples from biomedical applications show concepts and methods.
Prerequisite: calculus, linear algebra, and passing knowledge of differential equations.

BME 6905 Individual Work in Biomedical Engineering 1-4 Credits, Max 8 Credits
Grading Scheme: Letter Grade
Individual Work in Biomedical Engineering

BME 6907 BME Project 1-9 Credits, Max 12 Credits
Grading Scheme: S/U
BME Project
Prerequisite: BME MS non-thesis status.

BME 6910 Supervised Research 1-5 Credits, Max 5 Credits
Grading Scheme: S/U
Supervised Research

BME 6936 Biomedical Engineering Seminar 1 Credit, Max 4 Credits
Grading Scheme: S/U
Biomedical Engineering Seminar

BME 6938 Special Topics in Biomedical Engineering 1-4 Credits, Max 6 Credits
Grading Scheme: S/U
Special Topics in Biomedical Engineering

BME 6940 Supervised Teaching 1-5 Credits, Max 5 Credits
Grading Scheme: S/U
Supervised Teaching

BME 6971 Research for Master’s Thesis 1-15 Credits
Grading Scheme: S/U
Research for Master’s Thesis

BME 7979 Advanced Research 1-12 Credits
Grading Scheme: S/U
Research for doctoral students before admission to candidacy. Designed for students with master's degree in the field of study or for students who have been accepted for a doctoral program. Not appropriate for students who have been admitted to candidacy.

BME 7980 Research for Doctoral Dissertation 1-15 Credits
Grading Scheme: S/U
Research for Doctoral Dissertation

EGN 5949 Practicum/Internship/Cooperative Work Experience 1-6 Credits, Max 6 Credits
Grading Scheme: S/U
Practical cooperative engineering work under approved industrial and faculty supervision.
Prerequisite: graduate student.

EGN 6913 Engineering Graduate Research 0-3 Credits
Grading Scheme: S/U
Course will provide the student with supervised research in a laboratory setting.
ENU 6061 Survey of Medical Radiological Physics 1 Credit
Grading Scheme: Letter Grade
An overview of the areas of medical radiological physics including diagnostic radiography, nuclear medicine, and radiation therapy. Basic radiation physics, biology, and safety.
Prerequisite: undergraduate classical and modern physics, and differential equations.

ENU 6627 Therapeutic Radiological Physics 3 Credits
Grading Scheme: Letter Grade
Prerequisite: ENU 5615C, ENU 6051.

ENU 6651 Clinical Rotation in Radiation Therapy 3 Credits
Grading Scheme: Letter Grade
Experience in clinical therapeutic radiological procedures, patient dosimetry, and treatment planning.
Prerequisite: working knowledge of therapeutic radiological physics.