BME-Biomedical Engineering

BME 520. Implant-Tissue Interactions. 3 Hours.
An overview of implant biocompatibility including tissue histology, histopathology of implant response and the regulatory process for medical devices.

BME 524. Current Topics in Stem Cell Engineering. 3 Hours.
This course is designed for students interested in the field of stem cells, regenerative medicine, and tissue engineering using stem cells and stem cell derived cells. The course will introduce the role of stem cells in tissue growth and development, the theory behind the design and in vitro construction of tissue and organ replacements, and the applications of biomedical engineering principles to the treatment of tissue-specific diseases. Students will have hands on experience on culturing and analyzing stem cells, stem cell differentiation, analysis of functional and physiological properties of differentiated cells, and fabricating basic engineered-tissues.

BME 535. Tissue Engineering. 3 Hours.
Principles underlying strategies for regenerative medicine such as stem cell based therapy, scaffold design, proteins or genes delivery, roles of extracellular matrix, cell-materials interactions, angiogenesis, tissue transplantation, mechanical stimulus and nanotechnology.

BME 543. Medical Image Processing. 3 Hours.
Fundamental topics of medical image processing to practical applications using conventional computer software.

BME 544. Machine Learning for Biomedical Engineering Applications. 3 Hours.
This course provides the introduction to the practical aspects of machine learning such that the students can apply some basic machine learning techniques in simple biomedical engineering problems. The course also provides the principle of machine learning 'thinking process' for the next machine learning – AI courses and more in-depth machine learning studies. By 'thinking process', at the beginning, it is better to view machine learning like human learning. Students who have experience with Data Mining may further understand the fundamental differences between Machine Learning and Data Mining, although these two fields share many concepts and techniques. Also, the student will learn fundamental theories in machine learning to be able to develop new machine learning techniques and research machine learning in biomedical engineering.

BME 550. Computational Neuroscience. 3 Hours.
This course examines the computational principles used by the nervous system. Topics include: biophysics of axon and synapse, sensory coding (with an emphasis on vision and audition), planning and decision-making, and synthesis of motor responses. There will be an emphasis on a systems approach throughout. Homework includes simulations.

BME 555. NextGen-BioMed Bootcamp: Lab Skills for Biomed Research. 3 Hours.
The course will provide students with a solid foundation in the principles, methods, and techniques used in biomedical research. The course will cover a range of topics, including experimental design, cell and molecular biology techniques, immunological techniques, animal models and in vivo studies, and laboratory safety and good laboratory practices.

BME 561. Bioelectric Phenomena. 3 Hours.
Quantitative methods in the electrophysiology of neural, cardiac and skeletal muscle systems.

BME 562. Cardiac Electrophysiology. 3 Hours.
Experimental and computational methods in cardiac electrophysiology, ionic currents, action potentials, electrical propagation, the electrocardiogram, electromechanical coupling, cardiac arrhythmias, effects of electric fields in cardiac tissue, defibrillation, and ablation.

BME 565. Mechanobiology. 3 Hours.
The overall course objective is to develop understanding of mechanobiological processes in cells as they relate to both development and disease pathways. The course will focus on cancer and vascular biology, however there is significant overlap of these pathways with developmental signaling pathways. Students will learn not only molecular biology techniques for characterizing mechanobiology and cell phenotype but also be able to describe biomechanical analysis protocols including micropipette aspiration, atomic force microscopy, traction force microscopy, and optical/magnetic tweezers. The course will include comprehensive literature reviews relevant to the subject area. Students will present formal presentations on articles discussing mechanobiology topics; students will prepare a written report in the style of a commentary article on a published journal article discussing a relevant mechanobiological project.

BME 571. Continuum Mechanics of Solids. 3 Hours.
Matrix and tensor mathematics, fundamentals of stress, momentum principles, Cauchy and Piola-Kirchoff stress tensors, static equilibrium, invariance, measures of strain, Lagrangian and Eulerian formulations, Green and Almansistrain, deformation gradient tensor, infinitesimal strain, constitutive equations, finite strain elasticity, strain energy methods, 2-D Elasticity, Airy Method, viscoelasticity, mechanical behavior of polymers.

BME 572. Industrial Bioprocessing and Biomanufacturing. 3 Hours.
This course will introduces students to the growing industries related to biomedical, biopharmaceutical and biotechnology. It is targeted to offer the students marketable skills to work in a vital area of economic growth and also convey some of the challenges and opportunities awaiting.

BME 590. Special Topic in Biomedical Engineering. 1-3 Hour.
Special Topic in Biomedical Engineering.

BME 591. Individual Study in Biomedical Engineering. 1-6 Hour.
Individual Study in Biomedical Engineering.

BME 601. Seminar in Biomedical Engineering. 1 Hour.
Current topics in biomedical engineering technology and applications.

BME 605. Insights to Innovations BME Journal Club. 1 Hour.
Insights to Innovations (i2i) BME Scholar's Pulse is a Journal Club designed to facilitate critical analyses and discussion of current research in the field of biomedical engineering. Students will learn how to conduct literature searches, read and evaluate scientific articles, and present research findings effectively. Students will develop their presentation and discussion skills and gain a deeper understanding of the various subfields of biomedical engineering.

BME 617. Engineering Analysis. 3 Hours.
Advanced ordinary differential equations, transform techniques, scalar and vector field theory, partial differential equations (heat, wave, Laplace). Students who register for this course are expected to have successfully completed courses in calculus and ordinary differential equations.

BME 623. Skin and Bone Regeneration. 3 Hours.
Study of principles of healing, methods to enhance, and clinical applications.

BME 625. Immune-Engineering: Biomaterial Toolbox for Immune-Modulation. 3 Hours.
This course introduces immunology and engineering approaches to study and control immune response using biomaterials. The course is geared towards students/engineers without a deeply established background in immunology. Basic principles in immunology will be covered and contemporary research directions will be discussed based on articles from the primary literature. Biomaterials will be presented as a tool for modifying immune responses.

BME 634. Dynamical Biological Systems. 3 Hours.
This course considers the dynamics of biological systems at a variety of levels from the cell/molecular to the circuit and system levels. Biological systems are typically nonlinear and their behavior is not usually analytically solvable. Yet it is possible to use the tools of nonlinear dynamical systems theory to approach understanding. In addition, it is important to understand how robust control theory can be applied to describe systems for which an exact mathematical model does not exist. The goal of this course is to examine a number of examples in some detail to gain insight into the dynamics of regulation in biology.

BME 643. Biomedical Imaging-Oncology. 3 Hours.
Advanced and quantitative medical imaging and image processing to understand biological processes related to cancer biology. Medical imaging technology will include molecular, functional and anatomical imaging related to the hallmarks of cancer.

BME 664. Neural Computation. 3 Hours.
This course examines the principal theoretical underpinnings of computation in neural networks. Emphasis will be placed on understanding the relationship between the different approaches: dynamical systems, statistical mechanics, logic, Kalman filters, and likelihood/Bayesian estimation.

BME 665. Computational Vision. 3 Hours.
This course approaches the study of biological and artificial vision from a theoretical perspective beginning with a comparative survey of visual systems and then examining vision algorithms and architectures.

BME 670. Quantitative Physiology. 3 Hours.
Study of physiological problems using advanced mathematical techniques. Topics covered include: mechanics, fluid dynamics, transport, electrophysiology of cell membranes, and control systems.
Prerequisites: BME 517 [Min Grade: C] or BME 617 [Min Grade: C] or BME 717 [Min Grade: C] or ME 661 [Min Grade: C] or ME 761 [Min Grade: C]

BME 672. Cellular Therapy. 3 Hours.
Introduction to research in cellular therapy, its clinical applications, and its potential for commercialization. Students will learn fundamental mechanisms, become familiar with the progress of several successful therapies that use human T cells and stem cells, and learn the challenges and opportunities for future biopharmaceutical and biotechnology industries.

BME 673. Lab Rotation. 3 Hours.
Entering BME graduate students will work in the laboratories of 2 or 3 potential research mentors. The duration of each rotation period will be by mutual agreement between student and faculty but must be at least 4 weeks. The goal is for students to match with their primary research mentor by the end of the course.

BME 680. Biomolecular Modeling. 3 Hours.
Molecular modeling principles and applications. Students will perform hands-on exercises using molecular modeling tools and software. Students will learn the critical relationships among structure, function, and thermodynamic driving forces in structural biology and become able to utilize molecular modeling techniques to explore biological phenomena at the molecular level.

BME 690. Special Topics in Biomedical Engineering. 1-6 Hour.
Special Topics in Biomedical Engineering.

BME 691. Individual Study in Biomedical Engineering. 1-6 Hour.
Individual Study in Biomedical Engineering.

BME 693. Internship in Biomedical Engineering. 1-6 Hour.

BME 697. Journal Club. 1-3 Hour.
Journal Club.

BME 698. Non-Thesis Research. 1-12 Hour.

BME 699. Thesis Research. 1-12 Hour.
Prerequisites: GAC M

BME 701. Seminar in Biomedical Engineering. 1 Hour.
Current topics in biomedical engineering technology and applications.

BME 705. Insights to Innovation BME Journal Club. 1 Hour.
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BME 717. Engineering Analysis. 3 Hours.
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BME 723. Skin and Bone Regeneration. 3 Hours.
Study of principles of healing, methods to enhance, and clinical applications.

BME 725. Immune-Engineering: Biomaterial Toolbox for Immune-Modulation. 3 Hours.
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BME 780. Biomolecular Modeling. 3 Hours.
Molecular modeling principles and applications. Students will perform hands-on exercises using molecular modeling tools and software. Students will learn the critical relationships among structure, function, and thermodynamic driving forces in structural biology and become able to utilize molecular modeling techniques to explore biological phenomena at the molecular level.

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Special Topics in Biomedical Engineering.

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BME 793. Internship in Biomedical Engineering. 1-6 Hour.

BME 797. Journal Club. 1-3 Hour.
Journal Club.

BME 798. Non-Dissertation Research. 1-12 Hour.

BME 799. Dissertation Research. 1-12 Hour.
Prerequisites: GAC Z