Spring 2021 BME Courses

BME 275 Biomechanics (Prof. Seth Donahue), T/Th 11:30am-12:45pm

This course introduces the fundamental principles of biomechanics as used in the field of biomedical engineering. Students will realize how mechanical engineering fundamentals can be applied to analyses of the tissues and systems in the human body. Specific topics covered in this course include the mechanical behavior of bone and passive soft tissue, the mechanical behavior of neutrally stimulated skeletal muscle, the application of statics and dynamics to analyzing muscle and joint forces, the biomechanics of gait, orthopaedic biomechanics, and sport biomechanics.

BME 297M Strength of Materials (Prof. Scott Civjan), T/Th 1:00pm-2:15pm (offered through Civil Engineering, lab not required)

Analysis and design of structural members subjected to axial loads, torsion and bending deflection of beams, behavior of columns and transformation of stress and strain.

BME 397A/310 Intro to Lab Techniques (Dr. Sam Wojda, Dr. Qianbin Wang), online lecture

Lab sections (in-person) – Th 9:00am-12:00pm, F 9:00am-12:00pm

This course provides an introduction to laboratory techniques in biomedical engineering. Laboratory exercises and demonstrations will explore topics, such as data acquisition, whole body monitoring, cell culture technique, microscopy, and material property characterization of biological materials. Students will learn proper handling of laboratory chemicals, operate common analytical instruments, describe the theory and applications of various analytical instruments, and practice laboratory safety.

BME 320 Bioinstrumentation (Prof. Yu Chen), M/W 2:30pm-3:45pm (lecture)

Discussion sections – F 12:20pm-1:10pm, F 1:25pm-2:15pm

This course is intended to provide biomedical engineering students with an understanding of the principles and devices of biomedical instrumentation with emphases on analog and digital electronic circuits, transducers, instruments, and measurements for obtaining information from human body and/or biological systems.

BME 330 Quantitative Physiology (Prof. Cathal Kearney), T/Th 2:30pm-3:45pm

This course covers a quantitative description of the function and control of organ systems. Mathematical models are derived to describe physical principles and physiologic mechanisms.
BME 497C/415 Senior Design (Dr. Sam Wojda, Dr. Martin Hunter), T/Th 1:00pm-2:15pm

Lab sections (in-person) – M/W/F 1:00pm-4:00pm, T/Th 10:30am-12:00pm, T/Th 2:30pm-4:00pm
*Note: Student groups will sign up for 1.5 hour time slots after registration; time overlaps OK but overrides may be needed. Suggested to register for tech electives first, then request override for Senior Design if needed.

This is the second semester of biomedical engineering capstone design sequence. The scope of biomedical engineering design and development encompasses a wide variety of scientific and engineering fields. This is a project based course utilizing fundamental concepts involved in biomaterials, biomechanics, bioinstrumentation to solve biomedical engineering problems. In this course students will build upon their capstone design project from Senior Design I with engineering analysis and design optimization of their selected design concept, prototyping, testing, reporting and oral presentations.

BME 597K Biotransport (Prof. Chase Cornelison), T/Th 10:00am-11:15am

An introduction to transport phenomena in biological systems covering fundamental principles of fluid mechanics and mass transfer at the cellular, tissue, and organ levels. Topics include macroscopic and microscopic mathematical descriptions of physiological fluid mechanics in circulation and tissue and mass transport related to convection and diffusion in biological systems; transmembrane and transvascular transport; biochemical interactions; mass separations; and kinetics of biochemical reactions. Course material will be reinforced using examples in drug delivery, tissue engineering, bioengineered systems, and tumorigenesis.

BME 597MB Molecular, Cell, and Tissue Biomechanics (Prof. Yubing Sun), T/Th 4:00pm-5:15pm (offered through MIE dept.)

This course applies principles of continuum mechanics to a broad range of biomechanical phenomena. The topics include: introduction to cell biology, fundamentals of solid mechanics, mechanosensitive machineries in cells, mechanotransduction, cell mechanics, developmental biomechanics, etc. Experimental methods for measuring molecular mechanics, cell adhesion, migration and contraction, and tissue biomechanics will also be discussed. Most recent literature will be used as discussion materials to connect theories with research.

BME 597N Neuroengineering (Prof. Siyuan Rao), T/Th 11:30am-12:45pm

This course seeks to build a foundation of physical principles underlying neuroengineering techniques, including electrical, optical, and magnetic approaches to neural recording and stimulation. We will discuss neural recording probes and materials considerations that influence the quality of the signals and longevity of the probes in the brain. This will be accompanied by the discussion of evolution of neural probes from microwires in the 1950s, to Utah arrays in the
1980s, to modern Neuropixels, meshes, and fibers. We will then consider physical foundations for optical recording and modulation approaches. Materials physics of optical fibers, GRIN lenses, light-emitting devices, and photodetectors will be discussed and followed by the in-depth review of devices and systems involved in optogenetics, photometry, and endoscopy. Finally, the course will deliver an introduction to magnetism in the context of biological systems. We will focus on magnetic neuromodulation methods including transcranial magnetic stimulation and nanomaterials based approaches to remote control of neural activity. Students enrolled in the course will be tasked with 3 team projects that will be focused on designing electrical, optical, or magnetic neural interface platforms for specific neuroscience questions.

BME 597P Intro to Biophotonics (Dr. Martin Hunter), MWF 11:15am-12:05pm

This course covers basic concepts in electromagnetism and light-matter interactions of biomedical significance. Topics covered include: optical properties of biological cells, tissues and biomaterials; visible and near-infrared light absorption, scattering and fluorescence spectroscopy; advanced microscopy techniques, optical coherence tomography, vibrational spectroscopy, photacoustic imaging, photodynamic therapy and their relevance to human disease diagnostic and therapeutic applications.

BME 597U Immunoengineering (Prof. Prabhani Atukorale), WF 2:30pm-3:45pm

This course will first provide an understanding of basic immunology and then transition to apply these fundamental principles to the design of immunoengineering solutions to biomedical disease challenges. Basic immunological principles that we will cover in the first part of the course include the cells of the immune system and their function, innate and adaptive responses, antigen presentation, T and B cell responses, and immunological memory. In the second part of the course, we will focus on understanding how these basic principles are applied in the design of immunomodulatory nanomaterials, antibody engineering, systems immunology, and development of cell-based therapies. This application-oriented second part of the course will involve overviews of the scientific literature to cover this rapidly evolving field. Throughout the course, we will focus on the biomedical challenges of cancer and infectious disease.