Fall 2021 BME Courses

ENGIN 114 Intro to Biomedical Engineering (Dr. Martin Hunter), M/W/F 1:25pm-2:15pm

Lab sections: 01LL M 8:00am-9:55am
01LM W 8:00am-9:55am
01LN TH 11:30am-1:30pm

This course is intended to provide beginning engineering students with a clear overview of the field of biomedical engineering so they can confidently decide if they want to pursue biomedical engineering as a profession. Throughout the semester, students will develop basic skills in problem-solving, computation, design, and communication that will help them in all future engineering courses.

BME 210 Intro to Bioengineering/Biology for Engineers (Dr. Martin Hunter), M/W/F 12:20pm-1:10pm

This course is an introduction to core Biomedical Engineering principles, as well as an overview of critical facets of mammalian cell biology and human physiology important to practicing Biomedical Engineers. The course covers biological topics of cell division, DNA, receptor-ligand binding, matrix protein assembly, tissue engineering, and cell motility, using a quantitative engineering perspective. Within this biological framework, students learn the basic principles of mass and energy balances, as well as a brief introduction to thermodynamics and transport processes. (Gen. Ed. BS)

BME 230 Statics & Dynamics (Dr. Sam Wojda), M/W/F 11:15am-12:05pm

This course will develop an understanding of the principles of statics and dynamics. Specific topics covered in this course include force and moment vectors, resultants, principles of statics and free-body diagrams, applications to simple trusses, frames, and machines, properties of areas, second moments, internal forces in beams, laws of friction, principles of particle dynamics, mechanical systems and rigid-body dynamics, kinematics and dynamics of plane systems, and energy and momentum of two-dimensional bodies and systems. (Co-requisite: Math 233)

BME 300 Biomaterials (Prof. Chase Cornelison), T/Th 2:30pm-3:45pm

The primary objective of this course is to teach the chemistry and engineering skills needed to solve challenges in the biomaterials and tissue engineering area. This includes macromolecular chemistry & material science, physical characterization & properties, materials & biology, and focused biomaterial sections. The course will concentrate on fundamental principles in biomedical engineering, material science, and chemistry. This course uses a combination of lectures, guest lectures, student presentations, and self-directed learning to examine the structure and properties of hard materials (ceramics, metals) and soft materials (polymers, hydrogels).

BME H300 Biomaterials Honors Colloquium (Prof. Chase Cornelison), M 1:25pm-2:15pm

This colloquium is open to upper level BME students who previously took, or are currently enrolled in, BME300 and are pursuing BME Departmental Honors. The class will meet once weekly and use out-of-class readings/podcasts with in-class discussions to delve deeper into

synthesis, analysis, and especially application of biomaterials in medicine. The purpose of this course is to enhance your knowledge of translational biomaterials in a research setting by fostering your ability to read, critically analyze, and discuss relevant scientific research articles. At the end of the course, you will also compose an original "perspective" style manuscript (or other format) detailing your opinion on the future of biomaterials and the literature evidence supporting your argument. Topics to be discussed will be decided collectively.

BME 310 Intro to Lab Techniques (Dr. Sam Wojda), lecture M 8:00am-8:50am

Lab sections: 01LL W 8:00am-11:00am
01LM Th 9:00am-12:00pm
01LN F 8:00am-11:00am

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 414 Senior Design I (Dr. Sam Wojda, Dr. Martin Hunter, Dr. Qianbin Wang), T/Th 8:30am-9:45am

*This course is intended to lead students through the process of design including identification, invention and implementation of new solutions to biomedical challenges. Students will work on identifying a need in the field, understanding the design challenges and how to design a potential solution. This will cover ethics of design, regulations of design, searching for existing solutions, standards, a stakeholder analysis, market analysis and need, concept generation and screening. Students will learn how to include globalization and innovation into designs. *Note: This course is replacing BME 470 Ethics & Regulations*

BME 497B/430 Systems Biology (Prof. Yu Chen, Dr. Qianbin Wang), M/W 2:30pm-3:45pm

Discussion sections: 01AA F 12:20pm-1:10pm
01AB F 1:25pm-2:15pm

This course is intended to provide an introduction to dynamic mathematical modeling of cellular processes. The emphasis is on using computational tools to investigate models of cellular phenomena. Throughout the semester, students will develop skills to construct and analyze models of cellular networks, including: metabolic networks, signal transduction pathways, gene regulatory networks, and electrophysiology.

BME 597A/697A Nature's Materials (Prof. Seth Donahue), T/Th 11:30am-12:45pm

Material science and mechanical engineering approaches are used to explore the structure-function relationships of natural biomaterials. Principles that govern mechanical behavior are used to discuss design approaches for synthetic bio-inspired and biomimetic materials. The main focus is on structure/function relationships of materials. There is also emphasis on mechanical design and function, with some discussion of cellular interactions. Materials covered include skin, horn, nail, hoof, hair, wood, plants, spider silk, nacre, bone, tendon, ligament, cartilage, meniscus, and tissue engineering scaffolds. Topics for bio-inspired and biomimicked materials

include structural and energy absorbing materials and biomedical materials for clinical applications.

BME 597C/697C Clinical Orthopedics for Engineers (Prof. Stacyann Bailey), T/Th 4:00pm-5:15pm

This course provides an overview of the clinical diagnosis and contemporary treatment of major musculoskeletal disorders. The pathophysiology, epidemiology, and anatomy of the affected biological systems are covered. Students will develop an understanding of the challenges faced by clinicians, research scientists, and medical device manufacturing engineers. We will explore novel therapeutic approaches that integrate engineering and medicine to restore or improve function. Topics will include orthopedic trauma, sports injury, osteoporosis, and osteoarthritis.

BME 597D/697D Drug Delivery (Prof. Cathal Kearney), T/Th 2:30pm-3:45pm

This course covers the breadth of drug delivery, from systemically delivered nanoparticles to local drug releasing systems. The course will consider the pharmaceutics of drugs and their disease target, and describe how to engineer drug delivery systems for these scenarios. Mathematical models, clinical examples, industry trends, and emerging research topics will be covered throughout the course.

BME 597M/697M Biomedical Microfluidics (Dr. Qianbin Wang), M/W 4:00pm-5:15pm

This course is offered to junior or senior undergraduate students to introduce them to the field of biomedical microfluidics and biochips. It covers the fundamentals of microfluidic phenomena and microfabrication. The course also includes the design of microfluidic components and some biomedical applications of microfluidic systems. Lecture Topics:

- *Introduction: how to design a biochip?*
- *Basic principle: what is fluid?*
- *Microfabrication: how to create a tiny world?*
- *Biointerfaces: how devices interact with the human body?*
- *Application I: droplet microreactor- the terminator of the traditional chemical industry?*
- *Application II: organ on a chip- the end of animal testing?*
- *Application III: micro-delivery system- why don't we know a mosquito is biting us?*
- *Challenges and future directions: what is next?*

BME 597MB Molecular, Cellular and Tissue Biomechanics (Prof. Yubing Sun), T/Th 2:30pm-3:45pm

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. Home course MIE 597MB.

BME 597NS Nanomaterials and Sensors (Prof. Jinglei Ping), M/W 4:00pm-5:15pm

The course will cover nanomaterial science and sensor science and technology with an emphasis on nano-enabled sensors and biosensors. Same as home course MIE 597NS.