

# Biomedical Engineering (BME) Courses

## **BME3010 Biomaterials**

This course focuses on the properties, structure, and design of biomaterials, biologic response and integration with them, and clinical considerations to biomaterials in the development of medical devices. Biomaterials is an interdisciplinary field of material science, engineering mechanics, chemistry and biology. Topics include structure and properties of materials, biomaterial manufacturing processes, surface properties of materials, biological interactions with biomaterials, biological integration with biomaterials, wound healing, coatings and adhesives, drug delivery, and regulatory and ethical issues related to biomaterials.

Prerequisite(s): CHM1000, CHM1006, ENGN3075 or ENGN3077 (or concurrent), SCI2031.

Offered at Providence

3 Semester Credits

## **BME3020 Biomechanics**

Biomechanics is an undergraduate course that builds upon and applies the concepts in Physics I, Physics II, Statics, and Dynamics to human function and movement, and an introduction to viscoelasticity of tissues. This course covers the analysis of forces in static and dynamic biological systems, the application of stress and strain analysis to biological tissues, structure function relationships in tissues and organ systems, and instrumentation systems.

Prerequisite(s): ((PHY1011, PHY1016) or (PHY2011, PHY2016), (PHY1022, PHY1026) or (PHY2022, PHY2026)), ENGN3025 (or concurrent).

Offered at Providence

3 Semester Credits

## **BME4010 Medical Imaging Modalities**

This course presents the fundamentals of multiple modalities of biomedical imaging and biological signal recording and provides students with exposure to the critical topics in mathematics, physics and computer science that constitute the conceptual core of modern medical imaging. An additional goal of the course is to familiarize the students with the standard clinical and research applications of the several imaging modalities available in most large hospitals and research institutions. The course begins with basic concepts in digitizing analog signals (Fourier Transform, bandwidth of signal, sampling theorem) and the physics of interaction between electromagnetic waves, sound waves and biological tissues. Subsequent topics include the presentation of clinical biomedical imaging modalities (e.g., X-ray, CT, ultrasound, MRI, PET); physics of imaging modalities; recordings of biological signals (e.g., EEG, EcoG, ECG); the use of stimulation devices in the body (e.g., pacemakers, TMS, DBS, focused ultrasound); and emerging imaging modalities.

Prerequisite(s): ENGN2101, ENGN2102, ENGN3025, SCI2031, ((PHY1022 and PHY1026) or (PHY2022 and PHY2026)).

Offered at Providence

3 Semester Credits

## **BME4020 Interventional Physiology - Medical Device Innovation**

This course examines the development of medical devices, instrumentation, pharmaceuticals, and emerging technologies. It introduces students to many aspects of biomedical innovation including the research, design constraints, standards and regulations to create a commercial medical product. Cases studies are selected from existing and emerging technologies including heart valves, vascular stents, joint replacement devices and instrumentation, neural stimulation techniques, biometrics, and artificial intelligence/machine learning technologies. Students review the anatomical and physiological context and constraints for the technology or device and compare how the technology/device relates to existing therapies. In addition to the physical and physiological aspects of innovation, students learn about industry and manufacturing regulation and quality, clinical trials, and bioethical aspects of the technology.

Prerequisite(s): BIO1011, BIO1016, SCI2031.

Offered at Providence

3 Semester Credits

## **BME4030 Biomedical Engineering Design**

This capstone course is an intensive, semester-long, project-based course in which students select, plan for and design a novel device or technology or an improvement to an existing technology. Students work independently on a design or technical problem resolution or in project teams to apply acquired discipline-specific skills and knowledge, develop leadership and collaborative abilities, and refine critical thinking, problem solving skills and project management skills. This course reinforces issues of intellectual property, bioethics and safety. Students submit their work for regular phase reviews on specific time schedules to monitor project progress, troubleshooting, quality and functionality of the prototype.

Prerequisite(s): BME3010, BME3020, BME4020.

Offered at Providence

3 Semester Credits