

# BIOMEDICAL ENGINEERING

## CURRICULUM

### Master of Applied Science

#### DEGREE REQUIREMENTS

	Credits
Master's Thesis	(Milestone)
BE8002 Seminars in Biomedical Engineering	Pass/Fail
BE8001 Foundations of Biomedical Engineering	1
BP8114 Anatomy and Physiology for Med. Phys.	1
Three Elective credits (One may be BE8003)	3

### Master of Engineering

#### DEGREE REQUIREMENTS

	(Milestone)
Master's Project <b>OR</b> BME Internship	(Milestone)
BE8001 Foundations of Biomedical Engineering	1
BP8114 Anatomy and Physiology for Med. Phys.	1
Six Elective credits (One may be BE8003)	6
<b>OR</b>	
BE8001 Foundations of Biomedical Engineering	1
BP8114 Anatomy and Physiology for Med. Phys.	1
Eight Elective credits (One may be BE8003)	8

### Doctor of Philosophy

#### DEGREE REQUIREMENTS

	(Milestone)
Candidacy Examination	(Milestone)
Dissertation	(Milestone)
BE8002 Seminars in Biomedical Engineering	Pass/Fail
BE8001 Foundations of Biomedical Engineering	1
BP8114 Anatomy and Physiology for Med. Phys.	1
Two Elective credits (One may be BE8003)	2

#### ELECTIVES

BE8003 Directed Studies in Biomedical Engineering	1
BE8101 Rehabilitation Engineering	1
BE8102 Design of Bio-MEMS	1
BE8103 Computations in Genetic Eng.	1
BE8104 Biomedical System Modeling	1
BE8105 Advanced Medical Image Analysis	1
BE8106 Advanced Magnetic Resonance Imaging	1
BP8101 Stats for the Health Sciences	1
BP8110 Biomedical Ultrasound	1
BP8113 Advanced Imaging	1
CE8201 Model and Simulation- Chem Eng	1
CE8603 Advances in Biomaterials	1
CE8605 Nanobiotechnology	1
CE8606 Advanced Topics in Tissue Engineering	1
EE8105 Digital Signal Processing I	1
EE8111 Digital Signal Processing II	1
EE8202 Digital Image Processing I	1
EE8212 Digital Image Processing II	1

EE8606	Sel Topics: Biomedical Engr I	1
EE8610	Sel Topics: Biomedical Engr II	1
ME8115	Finite Element Methods in Engr	1
ME8130	Robotics	1
ME8150	Introduction to Microfluidics	1
ME8143	Micro and Nano Manufacturing	1

### **Doctoral Candidacy Examination**

The aim of the candidacy exam is to assess the originality and appropriateness of the proposed research, its relevance to the program, and the students' ability to complete the research and the program. The exam consists of a written and oral component as well as a formal thesis proposal. This is a "Milestone." Pass/Fail

### **Doctoral Dissertation**

Students are required to conduct advanced research in the area of biomedical engineering. A specific research topic must be chosen in consultation with the student's supervisor(s). The student will conduct the research under the direction of the supervisor(s). The student must submit a written dissertation to an examination committee, and make an oral presentation and defense of the dissertation to this committee. Through the dissertation, the student must demonstrate an original contribution of new knowledge to the field of research, competence in research and a deep understanding of knowledge in the area of research. This is a "Milestone." Pass/Fail

### **Master's Thesis**

Students are required to conduct advanced research. The topic is chosen in consultation with the student's supervisor(s). The student must submit the completed research in a thesis format to an examination committee and make an oral presentation and defence of the research thesis and results to this committee. Through the thesis, students are expected to demonstrate competence in research and a sound understanding of the specialty area associated with the research. This is a "Milestone." Pass/Fail

### **Master's Project**

The student is required to conduct an applied advanced research project on a topic related to biomedical engineering. The project topic is selected in consultation with the student's advisor and monitored by an advisory committee. On completion of the project, the results are submitted in a technical report format to an examining committee and the student will make an oral presentation of the report to the committee for assessment and grading of the project and the report. The student is expected to provide evidence of competence in the carrying out of a technical project and present a sound understanding of the material associated with the research project. This is a "Milestone." Pass/Fail

### **BME Internship**

The internship course allows MEng students enrolled in the Biomedical Engineering (BME) Graduate Program to participate in an internship to undertake a project relevant to the student's research interests and aligns with the goals of the BME program. Students are responsible for identifying host companies, securing their placements, and preparing an internship plan, subject to program approval. Internships are 150 hours (min) in duration normally spread over 8-10 weeks during a single semester. This is a "Milestone." Pass/Fail

### **BE8001 Foundations of Biomedical Engineering**

This course will introduce students to methods for proposing research topics and subsequently developing actionable plans for conducting research in biomedical engineering. Students will be provided with tools to frame their research plans within the specific context of their sub-discipline, as well as in the wider context of medical science, biomedical engineering and clinical practice. Students will be exposed to best practices in qualitative and quantitative Methods specific to biomedical engineering. This will include common mathematical methods, theoretical modeling and experimental procedures, as well as methods related to discovery, identification, description and explanation generation. Students will engage in developing a research proposal for the purpose of planning their specific research project. Specific focus will also be placed on research ethics, culminating in a mock application to and evaluation by the local Research Ethics Board. 1 Credit

### **BE8002 Seminars in Biomedical Engineering**

The course consists of regular research seminars in the general area of biomedical engineering, given by graduate student, faculty members, and guest speakers. MASc students are expected to give one presentation towards the end of their thesis. PhD students are expected to give one presentation before their candidacy exam and one presentation towards the end of the dissertation. Pass/Fail

### **BE8003 Directed Studies in Biomedical Engineering**

This course is for students who wish to gain knowledge in a specific area of biomedical engineering for which no graduate level classes are offered. This course would involve a directed study for which the student(s) would be given credit. Students wishing to take the class would be assigned a suitable class advisor most familiar with the specific area of interest. Students would be required to present the work of one term (not less than 90 hours in the form of directed research, tutorials and individual study) in an organized publication format. 1 Credit

### **BE8101 Rehabilitation Engineering**

Engineering principles underlying the design and utilization of devices for persons with disabilities. Exposure to fabrication and design techniques. Overview of existing technology, including: limb and spinal orthoses, limb prostheses, devices aiding mobility, seating aids, reachers, robotic aids, functional electrical stimulation; sensory aids, uses of microcomputers, workplace/home modifications, devices for the aged. Effects of national policies, and challenges of technology transfer. Antirequisite: BME705 1 Credit

**BE8102 Design of Bio-MEMS**

Biophysical and chemical principles of biomedical microelectromechanical systems (bioMEMS) for the measurement of biological phenomena and clinical applications. Micro and nanoscale devices for the manipulation of cells and biomolecules. Topics include solidstate transducers, optical transducers, electrochemical transducers, biomedical microelectronics, microfluidics, and hybrid integration of microfabrication technology. Antirequisite: BME804 1 Credit

**BE8103 Computations in Genetic Eng.**

This course will introduce the computational theory and implementation of molecular database searching and sequence alignment in the context of genetic engineering. It covers databases and Internet access, sequence homology searching, multiple alignment and sequence motif analysis, and protein structure modeling and function prediction. Antirequisite: BME808. 1 Credit

**BE8104 Biomedical System Modeling**

Mathematical modeling of biomedical systems. Lumped and distributed models of electrical, mechanical, and chemical processes applied to cells, tissues, and organ systems. 3 hours of labs per week. Antirequisite: BME809. 1 Credit.

**BE8105 Advanced Medical Image Analysis**

1 Credit

**BE8106 Advanced Magnetic Resonance Imaging**

1 Credit

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