

FACULTY OF ENGINEERING

Biomedical Engineering

Course List

| <i>Code</i> | <i>Course Title</i> | <i>Unit</i> |
|----------------------------------------------------------------------------|--------------------------------------------------|-------------|
| M.Sc. Programme in Biomedical Engineering (Full-time and Part-time) | | |
| EMB7010 | Introduction to Biomedical Engineering | 3 |
| EMB7020 | Basic Biomedical Science | 3 |
| EMB7110 | Medical Devices and Sensor Networks | 3 |
| EMB7120 | E-medicine Technologies | 3 |
| EMB7130 | Medical Robotics | 3 |
| EMB7140 | BioMEMS and Bio-Nanotechnology | 3 |
| EMB7150 | Smart Materials for Medical Applications | 3 |
| EMB7160 | Computational Modelling for Medical Applications | 3 |
| EMB7210 | Bioinformatics | 3 |
| EMB7310 | Prosthetics and Artificial Organs | 3 |
| EMB7320 | Virtual Medicine and Computer Aided Surgery | 3 |
| EMB7330 | Medical Imaging | 3 |
| EMB7910 | M.Sc. Project | 3 |

Course Description

EMB7010

Introduction to Biomedical Engineering

Definition, scope, basic principles and problems in biomedical engineering. Applications of technology to medicine and biology. Contemporary issues and roles of engineering applied to complex biological systems. Brief description of professional ethics.

EMB7020

Basic Biomedical Science

This course introduces students to the structure and function of anatomy, physiology, and chemical constituents of living systems. The course provides a system-based review of the structure and function, normal as well as abnormal, of cells, organs and systems. Emphases will be placed on those structures/functions that are important in biomedical engineering. Case studies will also be included to introduce the importance of medical sciences related to biomedical engineering.

EMB7110

Medical Devices and Sensor Networks

Origins of physiological signals. The mechanisms of bioelectrical, biochemical, biophysical, and biophotonic sensors. The principles of wearable medical devices for homecare and mobile health care system. Features of body sensor networks (BSN). Security issues for BSN. Multi-sensor data fusion for BSN. Wearable and implantable sensor integration. Wearable devices and sensors for monitoring, diagnosis, therapy, spots, etc. Applications of medical devices, biosensors, and BSN.

EMB7120

E-medicine Technologies

Concepts of tele-medicine, E-medicine, and M-health. Basic techniques in tele-medicine and M-health: communication systems and networks, medical devices, E-medical records, information security and confidentiality, medical data coding and compression, functions of PACS and HIS. Applications include: tele-surgery, tele-geriatrics, tele-monitoring and M- health etc.

EMB7130

Medical Robotics

Introduction to robotics and its applications in biomedical engineering including diagnosis, surgery, and medical simulation. Classification of robot systems, forward and inverse kinematics associated to manipulator motion, robot design, control, sensing, and programming.

EMB7140

BioMEMS and Bio-Nanotechnology

Introduction to MEMS and Nanotechnology, with focus on biomedical applications. Recent developments in BioMEMS, including micro-fluidic systems, integrated DNA analysis chips, and micro-fabricated bio-detection and cell-sorting systems. Recent advances in nanoscale biomedical applications, including AFM based bio-manipulation and bio-sensing, soft-lithography for DNA, proteins and cells, self-assembly of peptides and proteins, nanoscale drug delivery systems, and bio-nano-informatics fusion.

EMB7150

Smart Materials for Medical Applications

Overview of smart materials technology; characteristics of smart materials such as piezoelectric materials, magnetorheological fluids, and shape memory alloys; smart actuators and sensors; design of medical devices; modeling and analysis of integrated systems; applications in biomedical engineering.

EMB7160

Computational Modelling for Medical Applications

Overview of computational physics, with focus on medical applications; Shape modelling; Dynamical system modelling; Numerical integration of ODEs; Rigid body dynamics; Structured deformable objects; Constraints and nonsmooth contact; Unstructured transport phenomena in biomedical engineering; PDEs and application in biomedical applications; Computational fluid dynamics and its applications.

EMB7210

Bioinformatics

This course covers DNA and protein bioinformatics. It introduces basic programming techniques, sequence analysis, including alignment of sequence, database search, statistical analysis, phylogenetic trees, coring matrices, pattern recognition, and clustering structural prediction in bioinformatics.

EMB7310

Prosthetics and Artificial Organs

Basic concepts of biological prosthetic systems and artificial organs; Functional electrical stimulation; Restoration of movement of paralyzed arms and legs; Design of implantable

devices and systems; Replacements of kidney, lung, heart, and other organ functions and their electrical, mechanical, materials, chemical, pathological and surgical aspects.

EMB7320

Virtual Medicine and Computer Aided Surgery

Image guided surgery, including CT base, fluoro-image, and others; non-image guided surgery. Introduction to clinical applications. Virtual reality and surgical simulation. Augmented reality and image-guided minimally invasive surgery. Use of telerobotics in surgery. Surgical navigation.

EMB7330

Medical Imaging

The course introduces various diagnostic medical imaging modalities, such as projection radiography, conventional X-ray, computerized tomography (CT), nuclear medicine (PET and SPECT), ultrasound, and magnetic resonance imaging (MRI). Each of these modalities will be introduced from basic physical principles to the process of image formation. This course also reviews the basic signal processing techniques. Image processing and analysis will be introduced.

EMB7910

M.Sc. Project

The objective of this course is for students to get hands-on practical experience. Each student is required to design, simulate or test a medical device/ algorithm / bioinformatics database.

Study Scheme

M.Sc. Programme in Biomedical Engineering (Full-time and Part-time)

1. Coursework Requirement

Students are required to complete a minimum of 24 units for graduation.

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|------|----------------------------------------------------------------------|----------|
| (i) | Required courses: EMB7010, 7020 and 7910. | 9 units |
| (ii) | Elective courses*#^: | 15 units |
| | (a) EMB7110, 7120, 7130, 7140, 7150, 7160, 7210, 7310, 7320, 7330 | |
| | (b) *BBB5100, 5120, 5200, 5220, 6100, 6120, 6200 | |
| | (c) #ORT5034 | |
| | (d) ^HTI5115, 5124, 5126, 5127, 5134, 5151, 5153, 5155 | |

Total: 24 units

*Courses offered by Division of Biochemistry of the Chinese University of Hong Kong

Course offered by Division of Orthopaedics & Traumatology of the Chinese University of Hong Kong

^ Courses offered by Department of Health Technology and Informatics of the Hong Kong Polytechnic University

Remarks: 1. Students are allowed to take up to TWO non-EMB courses, but no more than ONE course from each of the above specified groups (b), (c) and (d); subject to approval of Divisions/Units concerned.

2. For the completed course of HTIXXXX with passing grade, students should apply for course and unit exemptions in order to fulfill the graduation requirement.

2. *Other Requirements*

- (a) IT Proficiency Requirement. (Please refer to “Student IT Competence”.)
- (b) Minimum cumulative GPA of 2.0.