# Curriculum Structure

## Study Program Requirements

Students are required to obtain a total of 30 units with all in pass grades for graduation.

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| Applicable to students admitted in 2019-20 and thereafter<br>i) Required courses: 6 units (BMEG 5710 and BMEG 5720)<br>ii) Elective courses: 24 units (Students may take MSc Project + 6 taught courses OR 8 taught courses) |
| **Total: 30 units** |

## Curriculum Structure

Each course requires one evening class per week over a 12/13-week semester.

- **Required Courses (normally offering on Semester 1):**

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| **Course code:** | **BMEG 5710** |
| **Course Title:** | **Introduction to Biomedical Engineering** |
| **Units:** | 3 |
| **Outline:** | 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. |

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| **Course code:** | **BMEG 5720** |
| **Course Title:** | **Basic Biomedical Science** |
| **Units:** | 3 |
| **Outline:** | 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 |

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| | biomedical engineering. Case studies will also be included to introduce the importance of medical sciences related to biomedical engineering. |

- **Elective Courses:**

****Offering of elective taught courses are subject to needs and availability per year****

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| **Course code:** | **BMEG 5530** |
| **Course Title:** | **Tissue Engineering** |
| **Units:** | 3 |
| **Outline:** | This course provides an overview on the fundamental elements of tissue engineering including stem cell, extracellular matrix, biomaterials, soluble factor, drug delivery, mechanotransduction and bioreactor and recent advances in these fields. This course helps the students to understand how knowledge and techniques from biochemistry, biology, material science and various engineering disciplines can be applied to promote the advancement in tissue engineering of various physiological systems. Basic level of knowledge in biomaterials, biology and biochemistry is recommended. |

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| **Course code:** | **BMEG5540** |
| **Course Title:** | **BioMEMs and Biophotonics** |
| **Units:** | 3 |
| **Outline:** | This course covers an introduction to MEMS and photonics technologies, with focus on biomedical applications. Topics include: introduction to cell and tissues, DNA and protein, recent developments in BioMEMS, micro-fluidic systems, integrated DNA analysis chips, micro-fabricated bio-detection and cell-sorting systems, interaction between light and biological materials, photoabsorption, emission and spectroscopy, bio-imaging principles and techniques, light-activated therapy, laser tweezers, and emerging MEMS and biophotonic technologies. |

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| **Course code:** | **BMEG 5730** |
| **Course Title:** | **Medical Devices and Sensor Networks** |
| **Units:** | 3 |
| **Outline:** | 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 |

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| | (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. |

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| **Course code:** | **BMEG 5750** |
| **Course Title:** | **Medical Robotics** |
| **Units:** | 3 |
| **Outline:** | 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. |

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| **Course code:** | **BMEG 5760** |
| **Course Title:** | **Bioelectronics and Nanotechnology** |
| **Units:** | 3 |
| **Outline:** | This course covers the essential elements of bioelectronics and nanotechnology specific to biomedical engineering.<br><br>The first part of this course (Bioelectronics) includes overview of bioelectronics, functional materials for bioelectronics, biomolecule-based transistors, electrochemical biosensors, device fabrication and characterisation, lab-on-a-chip, wearable devices, and implantable bioelectronics and bionics.<br><br>The second part of this course (Nanotechnology) includes introduction to nanotechnology, nanolithography, solution-based synthesis of nano-materials, characterisation techniques, scanning probebased biomanipulation, soft-lithography for DNA, proteins and cells, self-assembly of peptides and proteins, nanoscale drug delivery systems, and bio-nano-informatics fusion. |

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| **Course code:** | **BMEG 5790** |
| **Course Title:** | **Bioinformatics** |
| **Units:** | 3 |
| **Outline:** | This course covers DNA and protein bioinformatics. It introduces basic programming techniques, sequence analysis, including alignment of sequence, database search, statistical analysis, phylogenetic trees, scoring matrices, pattern recognition, clustering and structural prediction in bioinformatics. |

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| **Course code:** | BMEG 5820 |
| **Course Title:** | Virtual Medicine and Computer Aided Surgery |
| **Units:** | 3 |
| **Outline:** | 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. |

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| **Course code:** | **BMEG 5830** |
| **Course Title:** | **Medical Imaging** |
| **Units:** | 3 |
| **Outline:** | 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. |

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| **Course code:** | **BMEG 5840** |
| **Course Title:** | **Biomedical Engineering Laboratories** |
| **Units:** | 3 |
| **Outline:** | This course aims to provide students from different science & engineering backgrounds opportunities to learn how to fabricate simple medical materials and devices, how to collect data on human subjects and other biological samples, and how to analyze the results to address various health-related issues. The course starts with a series of lectures on the principles underpinning each of the planned laboratory modules. Students will then form teams to conduct a number of hand-on laboratory modules in different areas of biomedical engineering to achieve the course aims and learning outcomes. Examples of laboratory modules include fabrication of basic biomedical device for biosignal acquisition, advanced electrophysiological techniques, fabrication of biomaterials for drug deliveries, PCR and gel electrophoresis, confocal fluorescence microscopy, functional MRI data processing, biomedical imaging for musculoskeletal applications, measurement of interfacial pressure at body support surfaces, electromyography & exoskeleton hand robot, etc. |

| Course code: | BMEG 5850 |
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| Course Title: | Medical Device Regulatory Affairs and Intellectual Property |
| Units: | 3 |
| Outline: | This course provides an overview on medical device regulation and intellectual property. Regulatory affairs is how to get a medical product registered in different countries' health authorities. A registered product would demand a lot of technical documentation to prove its efficacy, safety, and quality. To successfully and smoothly register a product, knowledge and skills are required to deal with various key stakeholders in governments, testing centers, hospitals, and medical doctors. Intellectual Property, such as patent, is to protect the invention and to support licensing their rights to manufacturers in the medical device industry. |

| Course code: | BMEG 5860 |
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| Course Title: | E-Health Technologies |
| Units: | 3 |
| Outline: | 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-monitorning and M-health etc. |

| Course code: | BMEG 5870 |
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| Course Title: | Golden Age Opportunities and Sustainable Smart Ageing |
| Units: | 3 |
| Outline: | The course is designed to delve into the complex and rapidly evolving fields of aging biology and the healthy longevity industry to support sustainable smart ageing. By gathering local and international influential thinkers and leaders from various sectors to share innovative ideas and experiences on ageing, the course aims to bridge theoretical knowledge with real-world applications, preparing students for successful careers in biomedical engineering and healthcare sectors focused on golden age opportunities and healthy longevity. |

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| **Course code:** | **BMEG 5880** |
| **Course Title:** | **Stem Cell Fundamentals** |
| **Units:** | 3 |
| **Outline:** | This course provides an in-depth introduction to the fundamental knowledge and technologies related to stem cells, which have become increasingly significant in various areas of biomedical research, industrial research and development (R&D), clinical practice, and academic education. As advancements in stem cell technologies continue to transform healthcare and scientific inquiry, biomedical engineering (BME) students need to understand both the theoretical and practical aspects of this field. Designed specifically for students pursuing a degree in BME, the course emphasizes core concepts of stem cell biology while ensuring that the material remains accessible and applicable. Rather than diving deeply into complex biological mechanisms, the course focuses on essential principles that underlie stem cell science. Students will explore mainstream applications of stem cell technology, learning how to effectively translate biological sciences into innovative and practical solutions for real-world challenges. The curriculum covers a range of critical topics, including the definitions, criteria, and standards of "stemness," which serve as foundational concepts in the study of stem cells.<br><br>Additionally, the course will delve into the regulatory frameworks and ethical considerations that govern stem cell research and development, providing students with a comprehensive understanding of the responsibilities and implications associated with this research. Students will also engage with fundamental aspects of embryonic, fetal, and adult stem cell biology, allowing them to grasp the complexities of each type and its unique properties. By the end of the course, students will have a thorough understanding of the diverse roles that stem cells play across various biomedical fields. |

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| **Course code:** | **BMEG 5920 & BMEG5930** |
| **Course Title:** | **MSc Project** |
| **Units:** | **6 units (2 semester)** |
| **Outline:** | 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. |

- **Elective Courses offered by specified group**

*Remarks: Students are allowed to take up TWO elective courses from below list of specified groups; subject to approval of Divisions/Units concerned.*

| Courses offered by School of Life Sciences<br>For more details and latest information, please visit the website at http://www.bch.cuhk.edu.hk/msc/. | |
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| **Course code:** | **BBMS 5100** |
| **Course Title:** | **Perspectives in Biochemical Sciences** |
| **Units:** | 3 |
| **Outline:** | This course presents the latest developments and advancements in biochemical sciences as well as the current topics in the society. It aims to alert students the trends and recent breakthrough in biochemistry in medical research. Issues such as stem cell research and infectious diseases shall be examined in this course. |
| **Course code:** | **BBMS 5120** |
| **Course Title:** | **Biochemical Techniques of Forensic Analysis** |
| **Units:** | 3 |
| | The first part of the lecture covered in this course includes principles of genetics at the molecular level, physical and biochemical nature of hereditary materials, molecular mechanisms of DNA replication, mutation, and repair, molecular basis of genetic disorders and their diagnosis. The second part of the lecture covers collection and processing of biological samples from crime scenes, DNA analysis using RFLP and PCR-STR typing methods, interpretation of DNA typing results, and court presentation of such biological evidence. Mitochondrial DNA typing and Y chromosome DNA typing will also be discussed. |
| **Course code:** | **BBMS 5200** |
| **Course Title:** | **Molecular Biology and Genome Science** |
| **Units:** | 3 |
| | This course is designed to acquaint students with the field of biochemical technology. The course covers the basic recombinant DNA technology, contemporary applications of biochemical technology in DNA sequencing and |

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| | genome mapping, RNA biology and technology, drug discovery and development. Contemporary application of computing skills in data mining for biotechnological studies will also be discussed. Specifically, it includes the use of computational softwares and databases for DNA and protein sequence analysis. In addition, the recent advances in forensic DNA analysis, transgenic technology, and authentication of Chinese medicinal materials will also be discussed. |
| **Course code:** | **BBMS 5220** |
| **Course Title:** | **Biochemical and Biomedical Technology** |
| **Units:** | 3 |
| | This course is an extension of the other course "BBMS5200 Technology in Molecular Biology". It begins with an introduction to the basic principles of protein analyses. Modern approaches to identify and characterize cellular proteins will be introduced. Based on these technologies, bioengineering of proteins (e.g. enzymes and antibodies) which are of medical and industrial importance will be illustrated. The application of x-ray crystallography in protein structural studies will also be introduced. The course also covers the contemporary applications of biochemical technology in mammalian cell culture technology, stem cell biology and CAR-T cells biotechnology. |
| **Course code:** | **BBMS 6100** |
| **Course Title:** | **Biochemistry of Food Safety and Environmental Health** |
| **Units:** | 3 |
| | This course is concerned with the biochemical impacts in food and environment as they relate to the health of public. The first part introduces the key concepts and principles of food safety and toxicology. The nature and properties of the toxic substances in foods will be covered. Additionally, the impacts of nutrient deficiency to human health will be discussed. The second part addresses issues related to environmental health such as water management, sewage management and treatment, and pollution from hazardous biochemicals and chemicals. |
| **Course code:** | **BBMS 6120** |
| **Course Title:** | **Clinical Biochemistry and Diseases** |
| **Units:** | 3 |
| | This course provides students with an introduction to the normal pathways of carbohydrate, lipid, nucleotide and amino acid metabolism. The course will outline the biochemical mechanisms for controlling these pathways under different physiological and nutritional conditions and discuss the importance of diseases arising from defects in these pathways. Particular emphasis will be placed on the |

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| | biochemical mechanisms concerning the etiology, symptoms and treatment of diseases such as diabetes mellitus, atherosclerosis and other lipid disorders, inborn errors of carbohydrates and amino acid metabolism. Also, how biochemical test results are utilized for the diagnosis and monitoring of diseases are described |
| **Course code:** | **BBMS 6200** |
| **Course Title:** | **Methods in Biochemistry** |
| **Units:** | 3 |
| | This course will allow students to gain theoretical and practical, hands-on knowledge of various advanced research methodologies and their applications in biochemical research and pre-clinical services. Methods include:<br>• Ion exchange chromatography<br>• Spectrophotometry<br>• SDS-Polyacrylamide gel electrophoresis and Western blot analysis<br>• Enzymatic assay<br>• DNA cloning technologies and DNA electrophoresis<br>• PCR and site-directed mutagenesis<br>• Bacterial transformation and culture<br>• Recombinant protein expression and purification<br>• Human cell culture and cytotoxicity assay<br>• Fluorescence technology: flow cytometry, confocal microscopy, fluorescence spectrum scanning and measurement |
| **Course code:** | **BBMS 6300** |
| **Course Title:** | **Management and Accreditation of Biochemical Laboratory** |
| **Units:** | 3 |
| | The aims of this course are to introduce basic concepts and adequate skills of laboratory management, safety and quality assurance in biochemical laboratories. Special topics such as biochemical testing and manufacturing process, good laboratory practice, laboratory accreditation, genetic testing and experimental protocols and method validation etc., will be discussed. |

## Research postgraduate courses offered by Division of Biomedical Engineering

**For more details and latest information, please visit the website at http://www.bme.cuhk.edu.hk/new/mphil-phd.php**

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| **Course code:** | **BMEG 5610** |
| **Course Title:** | **Research Methods in Biomedical Engineering** |

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| **Units:** | 3 |
| | This course presents research methods in biomedical engineering, and primarily aims at preparing postgraduate students for basic research or employment in the clinic and biomedical industries. Students will learn relevant concepts and tools for analyzing data arising from quantitative and qualitative research in molecular, physiological, and clinical systems. This course focuses on developing students' ability to analyze research data and critique the scientific literature. |
| **Course code:** | **BMEG 5630** |
| **Course Title:** | **Fundamental Gene Therapy** |
| **Units:** | 3 |
| | The course is designed to provide students with foundational knowledge and technology related to gene therapy and genetic engineering. As research and applications in gene therapy gain increasing prominence in medical and biomedical fields, this course aims to equip students with essential insights into these areas, focusing on both fundamental concepts and their practical applications. The emphasis will be on translating biological sciences into biomedical engineering practices. Structured to accommodate students with minimal prior knowledge, the course covers key components such as the definitions of gene therapy and genetic engineering, gene delivery methods (including both viral and non-viral vectors), therapeutic antisense technologies, basic gene editing techniques, and typical clinical applications like CAR-T cell therapy. The curriculum will highlight biomedical engineering perspectives, encompassing relevant instrumentation and methodologies for gene sequencing, medical imaging, and related fields. |

| **Research postgraduate courses offered by Engineering Faculty** | |
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| **Course code:** | **ENGG 5404** |
| **Course Title:** | **Micromachining and Microelectromechanical Systems** |
| **Units:** | 3 |
| **Outline:** | Broad overview of microfabrication and microelectromechanical systems. Introduction to basic micromaching techniques such as photolithography, isotropic and anisotropic wet etching, dry etching, physical and chemical vapor deposition, electroplating, metrology, statistical design of experiments, MEMS release etching, stiction, and MEMS device testing. Review of MEMS microsensors, microactuators and microstructures. Topics include accelerometers, pressure sensor, optical switches, cantilever beams, thin-film stress test structures and bulk micromaching |

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| | test structures. Fundamentals of central dogma of molecular biology, cell and tissue biology. Principles of transduction and measurements of molecules, cells and tissues. |
| **Course code:** | **ENGG 5601** |
| **Course Title:** | **Principles of Biomechanics and Biomaterials** |
| **Units:** | 3 |
| | Biomechanics: biostatics, biodynamics, mechanics of biological solids. Biomaterials: metals, ceramics, synthetic polymers, natural polymers, composites; characterization of biomaterials; biomaterial scaffolds for regenerative medicine. Clinical applications in the musculoskeletal system, (including, sports, traumatology, and rehabilitation), cardiovascular system, and dentistry. |

**CMSC / ECLT / ELEG / IEMS / MAEG / SEEM 57xx-59xx Courses offered by other M.Sc. Programme from Divisions within the Faculty of Engineering.**

**For more details, please visit the website at http://www.erg.cuhk.edu.hk/.**

| **Undergraduate courses offered by Department of Biomedical Engineering** | |
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| **Course code:** | **BMEG 4220 / 4510 / 4520** |
| **Remark:** | The University allows MSc students to take at most 15% of the course unit requirement at undergraduate level, which means, among the 30 units, at most 3 units can be at undergraduate level. |

## Course and Unit Exemptions

As stipulated in the Policy on Course and Unit Exemptions for Postgraduate Students, the total number of units exempted may not exceed half of the required number.

Courses completed in undergraduate programmes may also be considered. However, only up to 15% of the total units required for graduation may be exempted by using undergraduate courses;

Please visit at https://www.gs.cuhk.edu.hk/download/VI-C.pdf for more details.