Subject to approval

BIOMEDICAL ENGINEERING

SYLLABUS

The syllabus applies to students admitted in the academic year 2019-20 and thereafter under the four-year curriculum.

Definition and Terminology

Each course offered by the Biomedical Engineering Programme (the Programme) shall be classified as either introductory level course or advanced level course.

A Discipline Core course is a compulsory course which a candidate must pass in the manner provided for in the Regulations.

A Discipline Elective course refers to any technical course offered by the Programme for the fulfillment of the curriculum requirements of the degree of BEng in Biomedical Engineering that are not classified as discipline core course.

Curriculum

The Curriculum comprises 240 credits of courses as follows:

Engineering Core Courses
Students are required to complete 42 credits of Engineering Core Courses.

Discipline Core Courses
Students are required to complete ALL discipline core courses (90 credits), comprising 48 credits of introductory core courses and 42 credits of advanced core courses.

Discipline Elective Courses
Students are required to complete at least 30 credits of discipline elective courses from any one of the following cognate areas, or a combination of courses from them:

- Advanced biomedical signals and systems
- Biomaterials and tissue engineering
- Biomechanics and biotransport
- Biomedical imaging technologies and applications
- Omics technologies
- Professional ethics

Elective Courses
Students are required to complete 12 credits of elective course(s) offered by the Biomedical Engineering Programme, or other departments within or outside of the Faculty of Engineering.

University Requirements
Students are required to complete:

a) 12 credits in English language enhancement, including 6 credits in "CAES1000 Core University English" and 6 credits in "CAES9531 Technical English for Biomedical Engineering";
b) 6 credits in Chinese language enhancement course "CENG9001 Practical Chinese for engineering students"; and
c) 36 credits of courses in the Common Core Curriculum, comprising at least one and not more than two courses from each Area of Inquiry with not more than 24 credits of courses being selected within one academic year except where candidates are required to make up for failed credits during the whole period of study.

Capstone Experience
Students are required to complete the 12-credit "BMED4010 Final year project" to fulfill the capstone experience requirement for the degree of BEng in Biomedical Engineering.

Internship
Students are required to complete the non-credit bearing continuous internship "BMED3020 Professional training (Internship)" for at least 6 weeks which normally takes place in the summer semester of their third year of study.

Degree Classification

The degree of Bachelor of Engineering shall be awarded in five divisions in accordance with BMED 15 of the Regulations for the Degree of Bachelor of Engineering in Biomedical Engineering and UG 9 of the Regulations for First Degree Curricula.

The details of the distribution of the above course categories are as follows:

The curriculum of BEng (Biomedical Engineering) comprises 240 credits of courses with the following structure:

UG 5 Requirements (54 credits)

Course Code	Course	No. of credits
CAES1000	Core University English	6
CAES9531	Technical English for Biomedical Engineering	6
CENG9001	Practical Chinese for engineering students	6
CC##XXXX	University Common Core Course (6 courses)*	36
Total for UG5 Requirements		54

* Students have to complete 36 credits of courses in the Common Core Curriculum, comprising at least one and not more than two courses from each Area of Inquiry with not more than 24 credits of courses being selected within one academic year except where candidates are required to make up for failed credits.

Engineering Core Courses (42 credits)

Course Code	Course	No. of credits
ENGG1300	Fundamental mechanics	6
ENGG1310	Electricity and electronics	6
ENGG1320	Engineers in the modern world	6
ENGG1330	Computer programming I	6
ENGG1350	Thermofluid mechanics	6
MATH1851	Calculus and ordinary differential equations	6
MATH1853	Linear algebra, probability & statistics	6
Total for Engineering Core Courses		42

Discipline Core Courses (90 credits)

Introductory Courses (48 credits)

Course Code	Course	No. of credits
BMED1207	Fundamentals of chemistry and biology for biomedical engineering	6
BMED2020	Engineering training	6
BMED2206	Engineering in biology and medicine	6
BMED2301	Life sciences I (Biochemistry)	6
BMED2302	Life sciences II (Cell Biology & Physiology)	6

BMED2500	Biomedical signals and linear systems	6
BMED2810	Engineering management and society	6
MECH2407	Multivariable calculus and partial differential equations	6
Total for Introductory Discipline Core Courses		48

Advanced Courses (42 credits)

Course Code	Course	No. of credits
BMED2600	Biomechanics for biomedical engineering	6
BMED3010	Integrated project	6
BMED3301	Life sciences III (Physiology)	6
BMED3501	Medical imaging	6
BMED3504	Biomedical engineering laboratory	6
BMED3600	Biomaterials science and engineering	6
BMED3603	Statistics and mathematical analysis for biomedical engineering	6
Total for Advanced Discipline Core Courses		42

Capstone Experience and Internship (12 credits)

Course Code	Course	No. of credits
BMED3020	Professional training (Internship)*	0
BMED4010	Final year project+	12
Total for Capstone Experience and Internship Courses		12

+Capstone Experience
*Internship

Discipline Elective Courses (30 credits)

30 credits of courses taken from any one of the following cognate areas, or a combination of courses from them:

Course Code	Course	No. of credits
Advanced biomedical signals and systems		
BBMS2008	Contemporary topics in biomedical technology	6
BMED4500	Biomedical instrumentation and systems	6
BMED4504	Biomedical signals processing and modeling in medical applications	6
ELEC3245	Control and instrumentation	6
Biomaterials and tissue engineering		
BBMS3012	Stem cell biotechnologies in regenerative medicine	6
BMED4601	Biomaterials design and applications	6
BMED4604	Cell and tissue engineering	6
Biomechanics and biotransport		
BBMS3018	Biomechanics and biomedical technologies	6
BMED4602	Molecular and cellular biomechanics	6
BMED4603	Transport phenomena in biological systems	6
Biomedical imaging technologies and applications		
BMED3500	Electromagnetics in biomedicine	6
BMED4501	Biophotonics	6
BMED4502	Magnetic resonance imaging: principles, technology and applications	6
BMED4503	Biomedical ultrasonics: principles and applications	6

Omics technologies		
BBMS2007	Essential molecular biology	6
BBMS3008	Essential proteomics	6
BBMS3009	Genome science	6
BIOC3605	Sequence bioinformatics	6
Professional ethics		
ELEC3845	Economics, finance and marketing for engineers	6
Complete at least five Discipline Elective Courses for a total of 30 credits		30

Elective Courses (12 credits)
At least 12 credits of courses offered by the Biomedical Engineering Programme, or other departments within or outside of the Faculty of Engineering.

Elective MSc(Eng) courses
Students may take up to two 6-credit MSc(Eng) courses offered by the Faculty as elective courses, subject to the approval of the Programme Director.

Summary of curriculum structure of BEng (Biomedical Engineering)

Course Categories	No. of credits
UG5 Requirements	54
Engineering Core Courses	42
Discipline Core Courses (Introductory)	48
Discipline Core Courses (Advanced)	42
Capstone Experience and Internship	12
Discipline Elective Courses	30
Elective Courses	12
Total	**240**

A suggested study plan is given as follows:

FIRST YEAR

Engineering Core Courses (36 credits)

ENGG1300	Fundamental mechanics	6
ENGG1310	Electricity and electronics	6
ENGG1320	Engineers in the modern world	6
ENGG1330	Computer programming I	6
MATH1851	Calculus and ordinary differential equations	6
MATH1853	Linear algebra, probability & statistics	6

University Requirements (UG5) (18 credits)

CAES1000	Core University English	6
CC##XXXX	Two Common Core Courses	12

Introductory Discipline Core Course (6 credits)

BMED1207	Fundamentals of chemistry and biology for biomedical engineering	6

SECOND YEAR

Engineering Core Course (6 credits)

ENGG1350	Thermofluid mechanics	6

Introductory Discipline Core Courses (42 credits)

BMED2020	Engineering training	6
BMED2206	Engineering in biology and medicine	6

BMED2301	Life sciences I (Biochemistry)	6
BMED2302	Life sciences II (Cell Biology & Physiology)	6
BMED2500	Biomedical signals and linear systems	6
BMED2810	Engineering management and society	6
MECH2407	Multivariable calculus and partial differential equations	6

University Requirements (UG5) (12 credits)

CC##XXXX	Two Common Core Courses	12

THIRD YEAR

Advanced Discipline Core Courses (42 credits)

BMED2600	Biomechanics for biomedical engineering	6
BMED3010	Integrated project	6
BMED3301	Life sciences III (Physiology)	6
BMED3501	Medical imaging	6
BMED3504	Biomedical engineering laboratory	6
BMED3600	Biomaterials science and engineering	6
BMED3603	Statistics and mathematical analysis for biomedical engineering	6

Internship (non-credit bearing)

BMED3020	Professional training (Internship)	0

University Requirements (UG5) (18 credits)

CAES9531	Technical English for biomedical engineering	6
CC##XXXX	One Common Core Course	6
CENG9001	Practical Chinese for engineering students	6

FOURTH YEAR

Capstone Experience (12 credits)

BMED4010	Final year project	12

Discipline Elective Courses (30 credits)

At least 30 credits must be selected from any one of the following cognate areas, or a combination of courses from them:

Advanced biomedical signals and systems

BBMS2008	Contemporary topics in biomedical technology	6
BMED4500	Biomedical instrumentation and systems	6
BMED4504	Biomedical signals processing and modeling in medical applications	6
ELEC3245	Control and instrumentation	6

Biomaterials and tissue engineering

BMED4601	Biomaterials design and applications	6
BMED4604	Cell and tissue engineering	6
BBMS3012	Stem cell biotechnologies in regenerative medicine	6

Biomechanics and biotransport

BBMS3018	Biomechanics and biomedical technologies	6
BMED4602	Molecular and cellular biomechanics	6
BMED4603	Transport phenomena in biological systems	6

Biomedical imaging technologies and applications

BMED3500	Electromagnetics in biomedicine	6
BMED4501	Biophotonics	6
BMED4502	Magnetic resonance imaging: principles, technology and applications	6
BMED4503	Biomedical ultrasonics: principles and applications	6

Omics technologies

BBMS2007	Essential molecular biology	6
BBMS3008	Essential proteomics	6
BBMS3009	Genome science	6
BIOC3605	Sequence bioinformatics	6

Professional ethics

ELEC3845	Economics, finance and marketing for engineers	6

University Requirements (UG5) (6 credits)

CC##XXXX	One Common Core Course	6

Elective Courses (12 credits)

COURSE DESCRIPTIONS

Candidates will be required to do the coursework in the respective courses selected. Not all courses are offered every semester.

Engineering Core Courses

ENGG1300	Fundamental mechanics (6 credits)
ENGG1310	Electricity and electronics (6 credits)
ENGG1320	Engineers in the modern world (6 credits)
ENGG1330	Computer programming I (6 credits)
ENGG1350	Thermofluid mechanics (6 credits)
MATH1851	Calculus and ordinary differential equations (6 credits)
MATH1853	Linear algebra, probability & statistics (6 credits)

Please refer to the Engineering Core Courses in the syllabus for the degree of BEng for details.

University Requirements on Language Enhancement Courses

CAES1000 Core University English (6 credits)
CENG9001 Practical Chinese for engineering students (6 credits)

Please refer to the University Language Enhancement Courses in the syllabus for the degree of BEng for details.

CAES9531 Technical English for Biomedical Engineering (6 credits)

The course aims to develop biomedical engineering students' ability to write and speak in their discipline. The course will focus on developing students' ability to write a technical report and give a technical presentation on a medical device they have developed. The English course will run alongside the BMED3010 Integrated project course. This course requires students to develop a portable medical device, such as electrocardiogram (ECG) recording device or pulse oximeters, from scratch, use the device to gain data, and use the obtained data to gain insights into human physiology. The students then need to write a report and give a presentation which explains a mixture of medical and engineering information. This English course will focus on the English language skills needed to complete these assignments. Students will be assessed using the report and the presentation they produce for the Biomedical Engineering course as well as a final written test and an out of class learning component.

Co-requisite: BMED3010
Assessment: 100% continuous assessment

BMED1207 Fundamentals of chemistry and biology for biomedical engineering (6 credits)

A. Chemistry for Biomedical Engineering
This section will provide foundation knowledge of chemistry important for establishing a sound basis for interdisciplinary units of study in biomedical engineering. Aspects of molecular structure and bonding, isomerism, chemical reactivity and water, molar calculations and biochemical thermodynamics are included as necessary for understanding functions of biological molecules in biomedical engineering.

B. Biology for Biomedical Engineering
This section will focus on basic structures of the biological macromolecules, proteins, nucleic acids, lipids, carbohydrates. For each class of molecule, links will be made to build relevance to biomedical engineering applications through active learning approaches.

C. Emerging Technologies in Biomedical Engineering
This section of the course will inspire exciting recent progress in molecular biomedical engineering, building on the basics taught in the course and providing a taster of the frontiers in biomedical engineering which will be built upon in later years.

Mutually exclusive with BIOC1600
Assessment: 20% practical work, 30% continuous assessment, 50% examination

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BMED2020 Engineering training (6 credits)

Knowledge and practical use of hardware and software tools for soldering, wire-wrapping, PCB design and production, virtual instrumentation hard design and production, software programming of LabView, CAD/CAM, prototyping, moulding and metrology.

Assessment: 100% practical work

BMED2206 Engineering in biology and medicine (6 credits)

This course is an overview of the essential areas in biomedical engineering, including technologies and applications in life sciences and medicine. The course is broadly divided into 4 areas: biomechanics and biomaterial; cell and tissue engineering; biomedical instrumentations and signals, and medical imaging. The global development and other issues, such as safety, ethics and industry will also be addressed. The course offers field trips, has a laboratory component to provide the students with some hands-on experience in the subject, and has a group project component to explore and understand current grand challenges in biomedical engineering

Assessment: 60% continuous assessment, 40% examination

BMED2301 Life sciences I (Biochemistry) (6 credits)

This course presents an overview and an understanding of the basic mechanisms underlying life processes. Topics include chemistry of life – pH, water, etc; fundamental bioenergetics; biomolecules and their functions; intermediary metabolism; enzymes and coenzymes; nucleic acids and genetic information.

Mutually exclusive with BIOC2600
Assessment: 40% continuous assessment, 60% examination

BMED2302 Life sciences II (Cell Biology & Physiology) (6 credits)

This course aims to provide a basic understand of the structure and function of cells and tissues within our body, including the structures and functions of the cell; the general organisation of epithelium and glands; the different types and functions of the connective tissues; the general organisation of the nervous tissues, muscle and skin tissues, bone marrow and lymphatic tissues. The second part of the course will provide the students with integrated knowledge of human physiology and pathophysiology that is relevant to biomedical engineering in such areas as organization of the body, homeostasis and excitable tissues; the cardiovascular system; the renal system, and some common disorders of the cardiovascular and renal systems.

Assessment: 30% continuous assessment, 70% examination

BMED2500 Biomedical signals and linear systems (6 credits)

Signals and linear system theory is fundamental to all engineering discipline, especially in the field of electrical, computer and biomedical engineering. This is a first course in signals and linear systems for engineering students without any pre-requisite knowledge in signal theory or signal processing other than some knowledge in fundamental calculus and use of complex numbers. The course uses simple real life examples of signals and systems to illustrate how signal theory can be used in practical application, and will including an introduction to MATLAB as a tool for signal analysis and system modelling.

This course aims to help students gain a firm understanding of the fundamentals of signal and linear systems concepts and theory using adequate mathematical and computing techniques to tackle simple signal processing problems. It serves as a pre-requisite course for many other courses including Digital Signal Processing, Control and Instrumentation, Communication Systems, and Digital Image Processing.

Specifically, the course covers the following topics: time-domain signal representation, periodic and aperiodic signals; spectral representation of signals, Fourier series and Fourier transform; system responses and linear system modelling; sampling, aliasing and analog-to-digital conversion; z-transform and concepts of poles and zeros; convolution; FIR filters and digital filtering; IIR filters and frequency response of digital filters; continuous-time systems and Fourier transform properties; application examples of signal analysis and processing.

At the end of the course, students should have a clear understanding of the fundamentals of signals and system theory to enable them to perform simple signal analysis and processing using both analytical method as well as using computing tools, link the mathematical representation of signals to some very simple real life signals and vice versa, and appreciate the applications of linear systems theory in solving some simple real life problems. In addition, students should be aware of the complexity of real life problems and the need to continue investigation in practice after graduation.

Assessment: 40% continuous assessment, 60% examination

BMED2600 Biomechanics for biomedical engineering (6 credits)

Stress and strain; bending and deflection of beams; structural failure and viscoelasticity; Kinematics of particles, momentum and energy principles; free vibration and kinematics of mechanisms; human gait and motion; bone fracture & fixation.

Assessment: 10% practical work, 20% continuous assessment, 70% examination

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BMED2810 Engineering management and society (6 credits)

The aims are to develop basic understanding of organization and management skills, professional ethics and legal foundation for the engineering discipline. Topics on engineering organization, project management and managerial skills, decision making processes, contingency and crisis management, leadership, corporate culture and philanthropy will be discussed. In order to provide a clear and right insight for engineering students to interact and contribute to the society, topics related to professional conduct, social responsibility, sustainability and safety issues, technology and environment, professional ethics are included. For the legal foundation, topics such as contract, intellectual property, tort, professional negligence and related law issues are discussed.

Mutually exclusive with ELEC3844
Assessment: 30% continuous assessment, 70% examination

BMED3010 Integrated project (6 credits)

This project is broadly centered around the topic of biomedical circuits. Its overall aim is to provide biomedical engineering students with a hands-on opportunity to develop a practical and functional biomedical device, such as an electrocardiogram (ECG) system or pulse oximeter based on simple electronic circuits from scratch and thereby learn more about the technical details of such devices. Upon completing this course, the student should be able to explain to others the practical importance and technical details of electronic circuits used for physiological measurements; (e.g. bio-potentials or blood oxygenation) to develop a standalone medical device package using basic electronic parts such as op-amp chips, resistors, and capacitors. Understand how proper design of circuits can play an important role in assisting medical diagnoses accordingly.

Pre-requisites: BMED2206 and BMED2500
Assessment: 100% practical work

BMED3020 Professional training (Internship) (0 credit)

This course aims to provide our students with on-the-job training in local or non-local companies or organizations so that they can integrate theory learning with practical applications; understand real-life organizational structure and business operation; learn how to build human relations with seniors and co-workers; and enrich personal resume for becoming engineering professional.

Assessment: 100% continuous assessment

BMED3301 Life sciences III (Physiology) (6 credits)

To provide the students with integrated knowledge of human physiology and pathophysiology that is relevant to biomedical engineering in such areas as (1) blood, blood clotting and immune response, (2) breathing and gas transport, (3) generation and transmission of nerve impulses, muscle contraction, bone, (4) the brain and its functions, autonomic system and reflexes, and (5) some disorders of the above.

Pre-requisite: BMED2302
Assessment: 30% continuous assessment, 70% examination

BMED3500 Electromagnetics in biomedicine (6 credits)

The aim of this course is provide students with knowledge of electromagnetics and its applications in biomedicine. Fundamental physics and mathematics in electricity and magnetism are discussed. Vector analysis is included. Topics on electricity include electric field, Gauss's law, divergence theorem, electric potential, capacitor, dielectrics, Poisson's and Laplace's equations, and work and electrostatic

energy. Topics on magnetism include magnetic field, Ampere's circuital law, Stokes theorem, magnetic flux, magnetic materials, and Faraday's law. Finally, Maxwell equations and particle accelerators for biomedical treatment are explained. Applications of electromagnetics in biomedicine are emphasized and integrated throughout the course.

Assessment: 10% practical work, 15% continuous assessment, 75% examination

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BMED3501 Medical imaging (6 credits)

Medical imaging is an indispensible technology in modern healthcare and biomedical research. It provides in vivo anatomical, physiological and functional information of the human body in normal, developing and pathological states. The rapid development in this field not only leads to better disease diagnosis and more accurate treatment efficacy assessment, but also paves the way for better understanding of living biological systems.

This course will focus mainly on the principles of conventional (X-ray and Ultrasound) and modern (Computerized Tomography – CT; Magnetic Resonance Imaging – MRI; Nuclear Imaging and Optical Imaging) imaging techniques applied to biological systems and in medical diagnoses and the interpretations of these images.

At the end of the course, students should gain a clear understanding in the physics, working principles and mathematics involved in the various imaging modalities covered. They should also be able to appreciate the interdisciplinary nature of the subject and learn the latest development or advancement in the field of medical imaging.

Pre-requisite: BMED2500 or ELEC3241
Assessment: 20% practical work, 10% continuous assessment, 70% examination

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BMED3504 Biomedical engineering laboratory (6 credits)

This course aims to provide the opportunity for students to have hands-on experience and develop fundamental experimental skills required in biomedical engineering. The course emphasizes biomedical engineering principles and experimental designs applied in human physiology, from cellular to tissue and organ levels. The course is comprised of four major lab modules: electrophysiology, characterization of cells and tissues, micromechanics of small objects, and biomedical imaging systems. State-of-the-art biomedical designs in these four areas will also be addressed.

Pre-requisites: BMED2206, BMED2301, BMED2302 and BMED2500
Assessment: 80% practical work, 20% continuous assessment

BMED3600 Biomaterials science and engineering (6 credits)

Bonds and crystal structure; defects in crystalline solids; diffusion; solidification; phase diagram; strength of materials; plastic deformation; recrystallization; grain growth; fracture of materials; fatigue life and fatigue crack growth; creep; corrosion; structure and properties of polymers; analytical and testing techniques; definitions in biomaterials science and engineering; history of biomaterials; structure and properties of biological materials; materials in biomedical applications.

Pre-requisites: ENGG1300, ENGG1350 and MATH1851
Assessment: 20% practical work, 10% continuous assessment, 70% examination

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BMED3603 Statistics and mathematical analysis for biomedical engineering (6 credits)

The ability to understand the fundamentals of biostatistics and to employ appropriate and quantitative statistical methods to analyze data generated from biomedical studies of different designs is a necessary requirement for biomedical engineering students. This is particularly important in their senior years when they are conducting their final year projects with first hand data to analyze. This course introduces the principles, concepts and methodologies of statistical planning and analysis for biomedical studies. Firstly, basic principles including probability, sampling distributions, hypothesis testing, statistical errors and power will be briefly reviewed using examples extracted from biomedical studies. Secondly, commonly used statistical tests, both parametric and non-parametric, including those for comparison studies such as the analysis of variance (ANOVA) and association studies such as regression and correlation, will be introduced. Thirdly, practical data management and statistical analyses for biomedical data will be conducted through learning the statistical software SPSS. Finally, some special topics useful for biomedical studies such as sample size planning, power analysis, sensitivity and specificity of diagnostic and screening tests, will be covered. Mathematical description and computational modeling of physiological systems has been a vastly growing field. The second part of the course thus introduces quantitative, engineering approaches to human physiology. Three major physiologic systems of the human body (nervous, circulatory, and skeletal) will be studied to exemplify the quantitative nature of human physiology. Well-established mathematical models, including the Hodgkin Huxley model, the cable equation, pressure-volume relationship, and the Hill model, will be elucidated. We will familiarize the students with the MATLAB programming tool to set up and solve governing (linear system and differential) equations and to analyze the output in response to input variables. At the end of the course, the students should have fundamental knowledge and natural mathematical/computational capability to investigate biomedical engineering problems beyond the physiologic systems studied in this course.

Pre-requisites: ENGG1330, MATH1851, MATH1853, BMED2302, BMED2500 and BMED3301
Assessment: 20% practical work, 20% continuous assessment, 60% examination

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BMED4010 Final year project (12 credits)

This course is a core course for all final year biomedical engineering students. It requires students to apply the knowledge they acquired throughout their academic studies to solving real-life biomedical engineering problems. Students are provided with an opportunity to pursue their own research interest under the supervision of teachers from both Engineering & Medicine. At the end of the course, students are required to present a dissertation or report on a topic consisting of design, experimental or analytical investigations. They will develop the ability to formulate and solve problems in biomedical engineering.

Assessment: 100% continuous assessment

BMED4500 Biomedical instrumentation and systems (6 credits)

This course introduces the essential principles of biomedical instrumentation and systems used for both diagnostic and therapeutic purposes from the level of human body, organs, cells, down to the molecular level. Their applications encompass a wide range of areas, ranging from healthcare, clinical applications to basic life science research. Examples include ECG, EEG; blood pressure sensors; DNA microarray; flow cytometry, cardiac pacemakers, defibrillators and laser surgery.

Pre-requisite: BMED2500
Assessment: 20% practical work, 40% continuous assessment, 40% examination

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BMED4501 Biophotonics (6 credits)

This is an introductory course in biophotonics covering: (1) The essential concepts of (i) basic ray optics, (ii) wave optics, e.g. interference and diffraction, and (iii) photon optics, e.g. laser principles. (2)

Interaction of light with biological cells/tissues and its significances and implications in optical bioimaging and other optical diagnostic and therapeutic applications. (3) State-of-the-art biophotonic instrumentations and technologies: optical bioimaging and microscopy (optical coherence tomography (OCT), fluorescence microscopy, multiphoton and other nonlinear optical microscopy), lab-on-chip biosenors, laser therapy, optical-fiber-based micro-endoscopy.

Assessment: 30% practical work, 30% continuous assessment, 40% examination

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BMED4502 Magnetic resonance imaging: principles, technology and applications (6 credits)

Magnetic Resonance Imaging (MRI); Nuclear Magnetic Resonance (NMR); MRI instrumentation; Pulse sequence; Signal processing and image reconstruction in MRI; Advanced MRI techniques; MRI applications.

Mutually exclusive with ELEC6067
Pre-requisite: BMED3501
Assessment: 25% continuous assessment, 75% examination

BMED4503 Biomedical ultrasonics: principles and applications (6 credits)

Ultrasound biophysics, scanning modes, data acquisition schemes, transducer basics; applications of ultrasound including imaging, flow analysis, therapy.

Mutually exclusive with ELEC6079
Assessment: 30% practical work, 30% continuous assessment, 40% examination

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BMED4504 Biomedical signals processing and modeling in biomedical applications (6 credits)

Fundamentals of biomedical signals (physiological origins, characteristics, and acquisition); modelling and analyses of biomedical signals (linear and nonlinear modelling, digital filtering, spectral analysis, time-frequency analysis, multi-variate biomedical signal processing, etc); pattern classification and diagnostic decision; practical and clinical applications of biomedical signals; project development.

Mutually exclusive with ELEC6081
Pre-requisite: BMED2500
Assessment: 25% practical work, 15% continuous assessment, 60% examination

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BMED4601 Biomaterials design and applications (6 credits)

Processing, structures and properties of biomaterials; tissue response to implants; biomaterial degradation; *in vitro* and *in vivo* assessment of biomaterials; implant failure; hard tissue repair; soft tissue repair; blood interfacing implants; drug delivery, nanotechnology in medicine; tissue engineering; prosthetic medical device classification; prosthetic medical device evaluation; prosthetic medical device regulation; medical device standards; ethical issues.

Pre-requisite: BMED3600
Assessment: 30% continuous assessment, 70% examination

BMED4602 Molecular and cellular biomechanics (6 credits)

The focus of this course is on the physics of molecular biology and the mechanics of the cell. Topics include: (1) Biopolymer (actin filaments, microtubules, DNA etc.) conformations and dynamics (random

walk model of polymers, worm-like chain model, persistence length, entropic driven elasticity); (2) Basic statistical mechanics and thermodynamics of solutions (entropy of mixing, Osmotic pressure); (3) Mechanics of the cell (membrane elasticity, cell shape, cell adhesion); and (4) Introduction to intermolecular interactions (electrostatic force, van der Waals force).

Assessment: 40% continuous assessment, 60% examination

BMED4603 Transport phenomena in biological systems (6 credits)

Basic equations of fluid mechanics; fluid flow in the circulation and tissues; transport in porous media; mass transport in biological systems; kinetics; heat conduction; heat convection; heat exchangers.

Pre-requisite: ENGG1350
Assessment: 40% continuous assessment, 60% examination

BMED4604 Cell and tissue engineering (6 credits)

This course firstly introduces the nature on cell and tissue organization, tissue dynamic processes including development, homeostatis and wound healing. Second, it reviews in detail the basic components of engineered tissues including cells, scaffolds and signals. For cells, important cellular-fate processes such as attachment, migration, proliferation, differentiation and apoptosis, and the cell culture technology will be reviewed before focusing on stem cells and their relevance in tissue engineering. For scaffolds, the analogous role of scaffolds and extracellular matrix of native tissues will be compared and the technological advancement in scaffold design and fabrication will be highlighted. On signals, different types of cell-regulating signals including soluble biofactors, insoluble matrix factors and cell-cell interactions and biophysical signals such as topological and mechanical signals will be introduced before an integrative summary on the application of these signals in designing stem cell niche can be made. Apart from employing these signals extrinsically, direct genetic manipulation of cells can also achieve the purpose of modifying cellular functions. The basic understanding and technological achievement of gene transfer and delivery and its applications in tissue engineering will be covered.

Pre-requisites: BMED1207, BMED2206, BMED2301, BMED2302 and BMED3301
Assessment: 20% practical work, 20% continuous assessment, 60% examination

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ELEC3245 Control and instrumentation (6 credits)
ELEC3845 Economics, finance and marketing for engineers (6 credits)

Please refer to the syllabus of the Computer Engineering/Electrical Engineering/Electronic Engineering programme for course description.

BBMS2007 Essential molecular biology (6 credits)
BBMS2008 Contemporary topics in biomedical technology (6 credits)
BBMS3008 Essential proteomics (6 credits)
BBMS3009 Genome science (6 credits)
BBMS3012 Stem cell biotechnologies in regenerative medicine (6 credits)
BBMS3018 Biomechanics and biomedical technologies (6 credits)
BIOC3605 Sequence bioinformatics (6 credits)

Please refer to the syllabus of the Bachelor of Biomedical Sciences programme for course description.