MEDICAL ENGINEERING

SYLLABUS

The syllabus applies to students admitted in the academic year 2012-13 and thereafter under the four-year curriculum.

Definition and Terminology

Each course offered by the Medical 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 Disciplinary Elective course refers to any technical course offered by the Programme for the fulfillment of the curriculum requirements of the degree of BEng (Medical Engineering) that are not classified as discipline core course.

Curriculum

The Curriculum comprises 240 credits of courses as follows:

General Engineering Courses
Students are required to successfully complete at least 36 credits of General Engineering Courses.

Discipline Core Courses
Students are required to complete ALL discipline core courses (90 credits), comprising 36 credits of introductory core courses and 54 credits of advanced core courses.

Disciplinary Elective Courses
Students are required to complete at least 30 credits of disciplinary elective courses in either Track I "Biomechanics, biomaterials and tissue engineering" or Track II "Biomedical signals, systems and imaging".

Elective Courses
Students are required to complete 12 credits of elective courses offered by other departments within or outside the Faculty of Engineering.

University Requirements
Students are required to complete:

a) Two English language courses, including the "CAES1000 Core University English" and the "CAES9531 Technical English for medical engineering", for a total of 12 credits;
b) One Chinese language enhancement course "CENG9001 Practical Chinese for engineering students", for a total of 6 credits; and
c) 36 credits of courses in the Common Core Curriculum, selecting at least one but no more than two courses from each Area of Inquiry.

Capstone Experience
Students are required to complete the 12-credit "MEDE4010 Final year project" to fulfill the capstone experience requirement for the degree of BEng in Medical Engineering.

Internship

Students are required to complete a 6-credit internship "MEDE3020 "Professional training (Internship)", which normally takes place after their third year of study.

Degree Classification

The degree of Bachelor of Engineering shall be awarded in five divisions in accordance with EN16 of Regulations for the Degree of Bachelor of Engineering and UG9 of the regulations for the 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 medical engineering	6
CENG9001	Practical Chinese for engineering students	6
CC##xxxx	University Common Core Course (6 courses)*	36
Total for UG5 Requirements		54

* Students can select not more than one course from each Area of Inquiry within one academic year and at least one and no more than two courses from each Area of Inquiry during the whole period of study.

Faculty General Engineering Courses (36 credits)

Course Code	Course	No. of credits
MATH1851	Calculus and ordinary differential equations	6
MATH1853	Linear algebra, probability & statistics	6
ENGG1111/ ENGG1112	Computer programming and applications/ Computer programming and applications I	6
PHYS1050	Physics for engineering students	6
ENGG1206	Introduction to biomedical engineering	6
ENGG1207	Foundations of biochemistry for medical engineering	6
Total for Faculty General Engineering Courses		36

Discipline Core Engineering Courses (90 credits)

Introductory Courses (36 credits)

Course Code	Course	No. of credits
MECH2407	Multi-variables calculus and partial differential equations	6
MEDE2020	Engineering training	6
MEDE2301	Life sciences I (Biochemistry)	6
MEDE2302	Life sciences II (Cell Biology & Physiology)	6
MEDE2500	Biomedical signals and linear systems	6

MEDE2810	Engineering management and society	6
Total for Introductory Discipline Core Engineering Courses		36

Advanced Courses (54 credits)

Course Code	Course	No. of credits
MEDE2600	Biomechanics for medical engineering	6
MEDE3010	Integrated project	6
MEDE3301	Life sciences III (Physiology)	6
MEDE3500	Electromagnetics in biomedicine	6
MEDE3501	Medical imaging	6
MEDE3504	Medical engineering laboratory	6
MEDE3600	Biomaterials I	6
MEDE3602	Thermofluids for medical engineering	6
MEDE3603	Statistics and mathematical analysis for medical engineering	6
Total for Advanced Discipline Core Engineering Courses		54

Capstone Experience and Internship (18 credits)

Course Code	Course	No. of credits
MEDE4010	Final year project[+]	12
MEDE3020	Professional training (Internship)*	6
Total for Capstone Experience and Internship Courses		18

+Capstone Experience
*Training

Disciplinary Elective Courses (30 credits)

30 credits of courses taken from either Track I or Track II, or a combination of both tracks below:

Track I: Biomechanics, biomaterials and tissue engineering

Course Code	Course	No. of credits
ELEC3845	Economics, finance and marketing for engineers	6
MEDE4500	Biomedical instrumentation and systems	6
MEDE4601	Biomaterials II	6
MEDE4602	Molecular and cellular biomechanics	6
MEDE4603	Transport phenomena in biological systems	6
MEDE4604	Cell and tissue engineering	6

Track II: Biomedical signals, systems and imaging

Course Code	Course	No. of credits
ELEC3245	Control and instrumentation	6
ELEC3845	Economics, finance and marketing for engineers	6
ELEC6067	Magnetic resonance imaging (MRI) technology and applications	6
ELEC6079	Biomedical ultrasound	6
MEDE4500	Biomedical instrumentation and systems	6
MEDE4501	Biophotonics	6

Elective Courses (12 credits)

At least 12 credits of elective courses offered by other departments within or outside the Faculty of Engineering

Summary of curriculum structure of BEng (Medical Engineering)

Course Categories	No. of credits
UG5 Requirements	54
General Engineering Courses	36
Discipline Core Engineering Courses (Introductory)	36
Discipline Core Engineering Courses (Advanced)	54
Capstone Experience and Internship Courses	18
Disciplinary Elective Courses	30
Elective Courses	12
Total	**240**

The proposed syllabus by study year is as follows:

FIRST YEAR

Core Engineering Courses (36 credits)

MATH1851	Calculus and ordinary differential equations
MATH1853	Linear algebra, probability and statistics
ENGG1111/	Computer programming and applications
ENGG1112	Computer programming and applications I
PHYS1050	Physics for engineering students
ENGG1206	Introduction to biomedical engineering
ENGG1207	Foundations of biochemistry for medical engineering

UG5 Requirements (24 credits)

CAES1000	Core University English
CC##XXXX	Three Common Core Courses

SECOND YEAR

Introductory Core Courses (42 credits)

MECH2407	Multi-variables calculus and partial differential equations
MEDE2020	Engineering training
MEDE2301	Life sciences I (Biochemistry)
MEDE2302	Life sciences II (Cell Biology & Physiology)
MEDE2500	Biomedical signals and linear systems
MEDE2600	Biomechanics for medical engineering
MEDE2810	Engineering management and society

UG5 Requirements (18 credits)

CC##XXXX	Three Common Core Courses

THIRD YEAR

Advanced Core Courses (48 credits)

MEDE3010	Integrated project
MEDE3301	Life sciences III (Physiology)
MEDE3500	Electromagnetics in biomedicine
MEDE3501	Medical imaging
MEDE3504	Medical engineering laboratory
MEDE3600	Biomaterials I
MEDE3602	Thermofluids for medical engineering
MEDE3603	Statistics and mathematical analysis for medical engineering

Training (6 credits)

MEDE3020	Professional training (Internship)

UG5 Requirements (12 credits)

CAES9531	Technical English for medical engineering
CENG9001	Practical Chinese for engineering students

FOURTH YEAR

Advanced Core Course (12 credits)

MEDE4010	Final year project

Disciplinary Elective Courses (30 credits)

At least 30 credits must be selected from either Track I or Track II, or a combination of both tracks:

Track I: Biomechanics, biomaterials and tissue engineering

ELEC3845	Economics, finance and marketing for engineers
MEDE4601	Biomaterials II
MEDE4602	Molecular and cellular biomechanics
MEDE4603	Transport phenomena in biological systems
MEDE4604	Cell and tissue engineering
MEDE4500	Biomedical instrumentation and systems

Track II: Biomedical signals, systems and imaging

ELEC3245	Control and instrumentation
ELEC3845	Economics, finance and marketing for engineers
ELEC6067	Magnetic resonance imaging (MRI) technology and applications
ELEC6079	Biomedical ultrasound
ELEC6081	Biomedical signals and systems
MEDE4500	Biomedical instrumentation and systems
MEDE4501	Biophotonics

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.

Faculty General Engineering Courses

ENGG1111 Computer programming and applications (6 credits)
ENGG1112 Computer programming and applications I (6 credits)
ENGG1206 Introduction to biomedical engineering (6 credits)
ENGG1207 Foundations of biochemistry for medical engineering (6 credits)
MATH1851 Calculus and ordinary differential equations (6 credits)
MATH1853 Linear algebra, probability and statistics (6 credits)
MECH2407 Multi-variables calculus and partial differential equations (6 credits)
PHYS1050 Physics for engineering students (6 credits)

Please refer to the General Engineering 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 degree of BEng for details.

CAES9531 Technical English for Medical Engineering (6 credits)

The course aims to develop medical 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 MEDE3010 Integrated project course.

Assessment: 100% continuous assessment

MEDE2020 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, mechanical component design and modeling, CAD/CAM, metrology, computational fluid dynamics.

Assessment: 100% practical work

MEDE2301 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.

Assessment: 30% continuous assessment, 70% examination

MEDE2302 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 medical 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

MEDE2500 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 medical 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: 20% practical work, 10% continuous assessment, 70% examination

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MEDE2810 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 & MEDE2814
Assessment: 30% continuous assessment, 70% examination

MEDE2600 Biomechanics for medical 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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MEDE3010 Integrated project (6 credits)

This project is broadly centered around the topic of biomedical circuits. Its overall aim is to provide biomedical or electronic engineering students with a hands-on opportunity to develop an electrocardiogram (ECG) amplifier circuit from scratch and thereby learn more about the technical details of bio-potential measurement devices. Upon completing this course, the student should be able to explain to others the practical importance and technical details of amplifier circuits used for ECG potential measurements; to develop an ECG amplifier on a breadboard as well as a standalone 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 measuring bio-potentials and assist in medical diagnoses accordingly.

Assessment: 100% practical work

MEDE3301 Life sciences III (Physiology) (6 credits)

To provide the students with integrated knowledge of human physiology and pathophysiology that is relevant to medical 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.

Assessment: 30% continuous assessment, 70% examination

MEDE3500 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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MEDE3501 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-requisites: MEDE2500 or MEDE2201 or MEDE2203 or ELEC3241
Assessment: 20% practical work, 10% continuous assessment, 70% examination

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MEDE3504 Medical 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.

Assessment: 80% practical work, 20% continuous assessment

MEDE3600 Biomaterials I (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.

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

MEDE3602 Thermofluids for medical engineering (6 credits)

Concepts and definitions in engineering thermodynamics; thermodynamic properties; first law of thermodynamics; basic concepts in fluid mechanics for medical engineering; dimensional analysis and similarity; introduction to mass transport; introduction to diffusion.

Assessment: 10% practical work, 10% continuous assessment, 80% examination

MEDE3603 Statistics and mathematical analysis for medical engineering (6 credits)

This course introduces the principles, concepts and methodologies of statistical planning and analysis for biomedical studies. The course is divided into five sections. 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. Fourthly, 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. Last but not the least, how to critically appraise the biomedical literature, such as understanding the common errors in design and conduct, analysis, presentation and interpretation of a study will be reviewed.

Assessment: 20% practical work, 20% continuous assessment, 60% examination

MEDE3020 Professional Training (6 credits)

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

MEDE4010 Final year project (12 credits)

This course is a core course for all final year medical engineering students. It requires students to apply the knowledge they acquired throughout their academic studies to solving real-life medical 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 medical engineering.

Assessment: 100% continuous assessment

ELEC3245 Control and instrumentation (6 credits)

Control systems and instrumentation methods are fundamental to many engineering disciplines. In this course, a general approach will be taken to study of control systems and instrumentation, so that the theory and methods are applicable to other disciplines at the system level. The course is aimed at providing a general understanding of the fundamental principles of control systems and instrumentation methods. The following topics will be covered in the course: system modeling, transient response, principles of feedback, root locus, frequency response methods, state-space models, introduction to digital control, instrumentation and measurement systems, electromagnetic compatibility, noise and interference. At the end of the course, students should have gained an understanding of the concepts and methodologies for the complete process of modeling, analysis and design of a feedback control system, including instrumentation technologies for measuring controlled variables.

Assessment: Please refer to the information provided by the Department of Electrical and Electronic Engineering

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

The aims of this course are to develop basic understanding of economics, finance and marketing for the engineering discipline. The syllabus includes macroeconomics, microeconomics, value chain, financial management, cost and profit, shares and bonds, accounting concepts and financial statements, cash flow, rate of return; risk management, investment portfolio, technical analysis; marketing management, marketing mix, marketing media, marketing plan, and business ethics.

Assessment: Please refer to the information provided by the Department of Electrical and Electronic Engineering

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ELEC6067 Magnetic resonance imaging (MRI) technology and applications (6 credits)

With advances in engineering and computing, an extraordinary body of imaging technologies and applications has developed over the last 25 years. Among the various in vivo imaging modalities available or under development today, magnetic resonance imaging (MRI) is one of the most versatile and valuable one. This course is basically divided into two parts, covering a variety of MR related topics in detail. The first part of the course will focus on the fundamental principles and hardware of MRI while the second part will be on the advanced MRI applications. At the end of the course, students should gain a thorough understanding in the principles of MRI and MR systems. They will also learn the latest state-of-the-art applications of MRI in research and clinical practices.

Assessment: Please refer to the information provided by the Department of Electrical and Electronic Engineering

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ELEC6079 Biomedical ultrasound (6 credits)

Ultrasound physics, imaging modes, data acquisition schemes, transducer modelling; other applications of ultrasound including flow analysis, microscopy, therapy. Previous exposure to medical imaging theory (e.g. MEDE 2007/MEDE3501 – Medical Imaging, or equivalent) is highly preferred.

Assessment: Please refer to the information provided by the Department of Electrical and Electronic Engineering

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ELEC6081 Biomedical signals and systems (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.

Assessment: Please refer to the information provided by the Department of Electrical and Electronic Engineering

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MEDE4500 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.

Assessment: 20% practical work, 40% continuous assessment, 40% examination

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MEDE4501 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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MEDE4601 Biomaterials II (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: MEDE2202 or MEDE3600
Assessment: 20% practical work, 80% examination

MEDE4602 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

MEDE4603 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: MEDE2005 or MEDE3602
Assessment: 30% continuous assessment, 70% examination

MEDE4604 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.

Assessment: 20% practical work, 20% continuous assessment, 60% examination