MEDICAL ENGINEERING

SYLLABUS

This syllabus applies to students admitted in the academic year 2012-13.

Definitions and Terminology

Each course offered for the BEng in Medical Engineering curriculum shall be classified as either introductory level course or advanced level course, and be assigned a Level --- One, Two or Three, in which Level One courses are generally classified as introductory courses whereas advanced courses includes Level Two and Three courses.

A *Compulsory course* is a course which a student must study. A *Core Engineering course* is a Compulsory course which a student must pass in the manner as stipulated in the Regulations.

The Projects shall include MEDE2008 Integrated Project and MEDE3002 Final-year Project.

The *training course* in this curriculum consists of MEDE1010 Engineering Training and MEDE2010 Professional Training (Internship).

An Elective course in Medical Engineering is a Level 2 or Level 3 course offered as an optional course for the curriculum.

Loading

The normal load for a student is 60 credits of courses (excluding summer semester) per academic year with 30 credits in each semester. Students are allowed to increase the loading by not more than 6 credits in a semester or decrease the loading by the equivalent number of credits which they have previously taken as additional loading and passed.

Curriculum Requirement

The curriculum comprises 180 credits of courses as follows:

(a) 108 credits of Core Engineering courses
(b) 24 credits of Compulsory courses
(c) at least 15 credits of elective courses in Medical Engineering
(d) 21 credits of courses satisfying the UG5 requirements:
    (i) Professional and technical communication for medical engineering students[1] (3 credits)
    (ii) Professional and technical oral communication for engineers (3 credits)
    (iii) Practical Chinese language course for engineering students[2] (3 credits)
    (iv) Two courses from the Common Core Curriculum, selecting no more than one course from each Area of Inquiry (12 credits)

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[1] Students pursuing the double degrees in BEng/BBA are required to take CAES1907 in lieu of CAES1511.

[2] Putonghua-speaking students should take CUND0002 or CUND0003. Students who have not studied Chinese language during their secondary education / who have not attained the requisite level of competence in the Chinese language to take CENG1001 can apply (i) to take credit-bearing Cantonese or Putonghua language courses offered by the School of Chinese especially for international and exchange students; OR (ii) to be exempted from the Chinese language requirement and take an elective course in lieu.

(e) at least 6 credits of Complementary Studies courses comprising:
  (i) Engineering management and society[3] (6 credits)
(f) Engineering training[3] (3 credits)
(g) Professional training[3] (3 credits)

To complete the degree requirement, a student must obtain at least 180 credits including all courses listed under (a) to (g).

Order of Study

Order of study is dictated by pre-requisite and co-requisite requirements. Generally, Level 1 course should be taken before Level 2 courses, Level 2 courses should be taken before Level 3 courses. Medical Engineering elective course can be taken in any order as long as pre-requisites are met.

Degree Classification

The degree of Bachelor of Engineering shall be awarded in five divisions in accordance with EN16 of the Regulations for the Degree of Bachelor of Engineering and UG9 of the Regulations for the First Degree Curricula.

The programme structure is as follows:

FIRST YEAR

Core Engineering Courses (Total 36 credits)
(The number in brackets is the number of credits of the particular course)

ENGG1015 Introduction to electrical and electronic engineering (6 credits)
ENGG1018 Introduction to Mechanical Engineering (6 credits)
ENGG1011 Introduction to biomedical engineering (6 credits)
MEDE0001 Life science I (Biochemistry) (6 credits)

either
ENGG1002 Computer programming and applications (6 credits)
or
ENGG1016 Computer programming and applications I (6 credits)

either
ENGG1003 Mathematics I (6 credits)
or
ENGG1004 Mathematics IA (3 credits) and
ENGG1005 Mathematics IB (3 credits)

UG5 Requirements (Total 21 credits)
CAES1511 Professional and technical communication for medical engineering students[1] (3 credits)

[3]Students pursuing the studies of double degrees in BEng/BBA are allowed a waiver from taking these courses, the credits of which will be replaced by the required courses in Finance, HRM or Marketing major offered by the Faculty of Business and Economics to satisfy the Medical Engineering Curriculum requirement.

CAES1515 Professional and technical oral communication for engineers (3 credits)
CENG1001 Practical Chinese language course for engineering students[2] (3 credits)
Two Common Core Courses (12 credits)

Engineering Training (Total 3 credits)
MEDE1010 Engineering training[3] (3 credits)

SECOND YEAR

Core Engineering Courses (Total 54 credits)
MECH2007 Mathematics II (6 credits)
MEDE0002 Life science II (Cell Biology & Physiology) (6 credits)
MEDE2001 Biomechanics for medical engineering (6 credits)
MEDE2002 Electromagnetics in biomedicine (6 credits)
MEDE2202 Biomaterials I (6 credits)
MEDE2005 Thermofluids for medical engineering (6 credits)
MEDE2007 Medical imaging (6 credits)
MEDE2008 Integrated project (6 credits)
MEDE2203 Biomedical signals and linear systems (6 credits)

Complementary Studies Course (Total 6 credits)
MEDE2814 Engineering management and society[3] (6 credits)

Professional Training (Total 3 credits)
MEDE2010 Professional training [3] (3 credits)

THIRD YEAR

Core Engineering Courses (Total 18 credits)
MEDE3002 Medical engineering final year project (12 credits)
LIFE2004 Life sciences III (Physiology) (6 credits)

Compulsory Courses [3] (Select 24 credits from the following courses)
MEDE2006 Statistical planning and analysis for biomedical studies (3 credits)
MEDE2009 Biophotonics (6 credits)
MEDE3001 Tissue engineering (3 credits)
MEDE3003 Biomaterials II (3 credits)
MEDE3005 Transport phenomena in biological systems (6 credits)
MEDE3006 Medical devices (3 credits)
MEDE3007 Molecular and cellular biomechanics (6 credits)

Elective Course in Medical Engineering[3] (Total 15 credits)
Recommended Elective Course
BIOC3608 Sequence bioinformatics (6 credits)
ELEC1401 Computer organization and microprocessors (6 credits)
ELEC2815 Economics, finance and marketing for engineers (6 credits)
ELEC6067 Magnetic resonance imaging (MRI) technology & applications (3 credits)
ELEC6079 Biomedical ultrasound (3 credits)
MECH6045 Nanotechnology: fundamentals and applications (3 credits)

Additional Elective Course

Group A: Biomechanics, Biomaterials and Tissue Engineering

MECH2018 Dynamics and control (6 credits)
MECH2005 Design and manufacture (6 credits)
MECH6024 Applied mathematics for engineers (3 credits)

Group B: Medical Electronics and Biomedical Imaging
ELEC2204 Digital signal processing (6 credits)
ELEC2205 Control and instrumentation (6 credits)
ELEC2302 Digital system design (6 credits)
ELEC2601 Human computer interaction (6 credits)
ELEC3222 Robotics (6 credits)
ELEC3225 Digital imaging processing (6 credits)
CSIS0278 Introduction to database management systems (6 credits)

The list of Elective courses in Medical Engineering is updated regularly and some courses may not be offered every year. Students are encouraged to consult the Programme Director or other teachers in Medical Engineering for advice on planning their curriculum, especially in the third-year.

Double degrees in BEng/BBA option

Students pursuing studies for the double degrees in BEng/BBA curriculum are required to satisfy all the requirement of the above BEng curriculum and pass 54 credits of courses as listed below:

Course Code	**Course**	**Credits**
BUSI1002	Introduction to accounting	6
BUSI1003	Introduction to management information system	6
BUSI1004	Marketing	6
BUSI1007	Principles of management	6
ECON1001	Introduction to economics I	6
FINA1003	Corporate finance	6
BUSI0027	Management accounting I	6
	Business Electives (Any 2 courses in Finance, HRM or Marketing major)	12
	Total	**54**

<u>Exemption rule for students pursuing the BEng/BBA double degrees option:</u>

For students pursuing the double degrees in BEng/BBA option, they are deemed to have satisfied the following courses:

6 credits of Complementary Studies
9 credits of Elective course in Medical Engineering
3 credits of Engineering training
3 credits of Professional training (Internship)
3 credits of Compulsory course

after they have successfully completed all the courses from the following list:

Course Code	Course	Credits
BUSI1002	Introduction to accounting	6
BUSI1003	Introduction to management information systems	6
BUSI1004	Marketing	6

BUSI1007	Principles of management	6
ECON1001	Introduction to economics I	6
FINA1003	Corporate finance	6
BUSI0027	Management accounting I	6

Exemption rule for students pursuing the minor in FBE:

Students pursuing studies for Minor in Business/Economics/Finance are required to satisfy all the requirement of the above BEng curriculum and pass 36 credits of courses as prescribed by the Faculty of Business and Economics (information also available from http://engg.hku.hk/).

Furthermore, such students are deemed to have satisfied 6 credits of Elective (ELEC2815 Economics, finance and marketing for engineers) and 3 credits of Engineering Training (MEDE1010) after they have successfully completed 12 credits of courses from the following list.

Course Code	Course	Credits
BUSI1002	Introduction to accounting	6
BUSI1004	Marketing	6
BUSI1007	Principles of management	6
ECON1001	Introduction to economics I	6
ECON1002	Introduction to economics II	6
ECON2101	Microeconomic theory	6
ECON2113	Microeconomic analysis	6
FINA1003	Corporate finance	6
FINA2802	Investments and portfolio analysis	6

COURSE DESCRIPTIONS

LEVEL ONE

ENGG1002 Computer programming and applications (6 credits)
ENGG1003 Mathematics I (6 credits)
ENGG1004 Mathematics IA (3 credits)
ENGG1005 Mathematics IB (3 credits)
ENGG1018 Introduction to Mechanical Engineering (6 credits)
ENGG1011 Introduction to biomedical engineering (6 credits)
ENGG1015 Introduction to electrical and electronic engineering (6 credits)
ENGG1016 Computer programming and applications I (6 credits)

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

MEDE0001 Life science 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

CAES1511 Professional and technical communication for medical engineering students (3 credits)

There are two elements in this first-year course. Part one – Spoken and written academic / professional English skills. Students will present the engineering and medical aspects of a Medical Engineering problem through a poster presentation. This poster presentation will be co-assessed by members of the Centre for Applied English Studies and the Medical Engineering Team. While doing this task, students will also learn interviewing skills, and the skills for holding meetings and writing minutes. Part Two – Medical terminology word analysis skills. Students will be taught how to break down and understand medical terminology through an analysis of common medical prefixes, roots and suffixes.

Assessment: 100% continuous assessment

CAES1515 Professional and technical oral communication for engineers (3 credits)

This course focuses on students developing technical and professional spoken English skills. Throughout the course, the students will give a series of presentations which will help them to improve skills such as accessing, abstracting, analyzing, organizing and summarizing information; asking questions and negotiating meanings; making effective grammatical and lexical choices and using visual aids to ensure meaning is clear. The presentations give the students an opportunity to develop the skills to talk about general issues in Engineering in the Hong Kong context, engineering theories and their practical applications and also require them to present a detailed exploration of one aspect of engineering related to their chosen major.

Assessment: 0% practical work, 100% continuous assessment, 0% examination

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CENG1001 Practical Chinese language course for engineering students (3 credits)

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

MEDE1010 Engineering training (3 credits)

Design & model making, computational fluid dynamics (CFD), material processing, rapid prototyping, machining & metrology, CAD/CAM, soldering, wire wrapping, printed circuit boards (PCBs), use of wire wrapping tools, virtual instrumentation.

Assessment: 75% practical work, 25% continuous assessment

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12 credits of courses from the Common Core Curriculum

LEVEL TWO

MECH2007 Mathematics II (6 credits)

Complex variables; Fourier series and Fourier transforms; partial differential equations; introduction to probability and statistics; elementary numerical analysis.

Assessment: Please refer to the information provided by the Department of Mechanical Engineering

MEDE0002 Life science II (Cell Biology and 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

MEDE2001 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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MEDE2002 Electromagnetics in biomedicine (6 credits)

The aim of this course is two-folded. First, 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 transmission lines are explained. Second, emphasis is placed on the biological aspects of electromagnetism. Sections on biomedical applications of electromagnetism cover the biomedical instrument – linear accelerator (cyclotron, proton treatment facility). Sections on bioelectromagnetism and bioelectromagnetics cover electromagnetic fields generated by biological systems and the biological interaction with electromagnetic fields.

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

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MEDE2005 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

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MEDE2007 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.

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

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MEDE2008 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

MEDE2203 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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MEDE2202 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

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MEDE2814 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.

Assessment: 30% continuous assessment, 70% examination

MEDE2010 Professional training (3 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

LEVEL THREE

MEDE3002 Medical engineering 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

LIFE2004 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

MEDE2006 Statistical planning and analysis for biomedical studies (3 credits)

To understand the principles and concepts in statistical methodology commonly used for biomedical investigations; to apply the statistical tools in planning for biomedical studies, managing and analyzing data generated from these studies; to appreciate the principles and concepts for critical appraisal of biomedical literature

Assessment: 20% continuous assessment, 80% examination

MEDE2009 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: 60% continuous assessment, 40% examination

MEDE3001 Tissue engineering (3 credits)

To understand the basic composition of engineered tissues; appreciate the breadth and depth of the engineering considerations when designing tissue substitutes; introduce the current technological advances enabling the tissue engineering sectors and the future trends; review some real examples of engineered tissue, skin and cartilage as the only marketed products and candidates in R&D stage; outline other key issues such as safety and regulations.

Assessment: 20% practical work, 80% examination

MEDE3003 Biomaterials II (3 credits)

To provide students with criteria for and medical use of various biomaterials in human body tissue repair; to keep students updated with the most recent developments in the biomaterials and tissue engineering field and also future directions; to equip students with a broad knowledge of prosthetic medical devices; to make students aware of prosthetic medical device regulations and standards for materials and dev ices as well as ethical issues

Pre-requisite: MEDE2004 / MEDE2202
Assessment: 20% continuous assessment, 80% examination

MEDE3005 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 equivalent
Assessment: 30% continuous assessment, 70% examination

MEDE3006 Medical devices (3 credits)

Provides a practical introduction to various medical devices in modern healthcare industries, including the basic principles and applications of commonly used medical instruments and devices, monitoring and analysis equipment, therapeutic equipment, software systems, and the safety and regulatory issues.

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

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MEDE3007 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

Elective Courses in Medical Engineering

BIOC3608 Sequence bioinformatics (6 credits)

Please refer to the information provided by the Department of Biochemistry

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ELEC1401 Computer organization and microprocessors (6 credits)

This course aims at providing fundamental knowledge on the principles of computer organization and microprocessors, and serves as the first course to other more advanced computer courses. In order to bring out the essential principles, a simple processor is used for illustration and is studied in detail, and on top of it, more general systems are also introduced.

Specifically, the course covers the following topics: integer and floating point number representations; basic computer building blocks; register transfers and phases of instruction execution; micro-computer system organization - bus signals, timing, and address decoding; study of a simple model microprocessor: signals, instruction set and addressing modes; subroutines; reentrancy; context

switching; I/O programming; interrupt I/O and DMA; memory cells and systems; exception handling; assembler, linker and loader.

Mutually exclusive with: CSIS1120
Assessment: Please refer to the information provided by the Department of Electrical and Electronic Engineering

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ELEC2815 Economics, finance and marketing for engineers (6 credits)

The aims 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 (3 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 (3 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 – Medical Imaging, or equivalent) is highly preferred.

Prerequisite: MEDE2007 or MEDE3501
Assessment: Please refer to the information provided by the Department of Electrical and Electronic Engineering

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MECH6045 Nanotechnology: fundamentals and applications (3 credits)

Characteristic length scales, nanomaterials, nanostructures, physical properties of nanostructures, deposition techniques of nanofabrication, high resolution analysis and characterization, scanning probe methods, nanoindentation, deformation of nanostructures, mechanical behaviours of nanocrystalline solids, ultra-high strength of nanostructures, sensors, actuators, MEMS, NEMS,

functional nanomaterials, nano-scale devices, modelling and computer-aided designs, bio-nanotechnology.

Assessment: Please refer to the information provided by the Department of Mechanical Engineering

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MECH2018 Dynamics and control (6 credits)

Advanced rotational motion; balancing of rotating and reciprocating masses; forced vibration of single degree of freedom systems; vibration measurement, isolation and control; torsional vibration of multi-rotor systems; free transverse vibration of shafts; modeling of physical systems; time response analysis of dynamical systems; feedback control systems; control system design and applications; stability; root locus method.

Assessment: Please refer to the information provided by the Department of Mechanical Engineering

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MECH2005 Design and manufacture (6 credits)

Material selection; joining and fastening; jigs and fixture design; power transmission system design; CNC machining; rapid prototyping.

Assessment: Please refer to the information provided by the Department of Mechanical Engineering

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MECH6024 Applied mathematics for engineers (3 credits)

Statistical and numerical methods in engineering; hypothesis testing; estimation of parameters and confidence intervals; correlation coefficient; direct and iterative methods for systems of equations; numerical analysis; finite difference and finite element schemes; wave propagation and vibration; normal modes.

Assessment: Please refer to the information provided by the Department of Mechanical Engineering

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ELEC2204. Digital signal processing (6 credits)

This course aims to help students gain a firm understanding of digital signal processing theory and practice. It includes the discussion on the theoretical aspect of the interfaces between the continuous-time domain and the discrete-time domain, and the design of discrete-time infinite impulse response filters as well as finite impulse response filters. It also covers the formulation of convolution, correlation and fast algorithms. Moreover, it outlines the derivation of discrete Fourier transform, from which a detailed study of fast Fourier transform algorithms is given. It concludes by the study of sampling rate conversion and its application.

Specifically, the course covers the following topics in, digital signal processing: DSP fundamentals, filter structures, analog-to-digital conversion, digital-to-analog conversion, design of IIR filters, design of other frequency selective filters, design of FIR filters, digital convolution, cross- and auto-correlation, fast convolution, discrete Fourier transform, fast Fourier transform algorithms, decimation, interpolation, sampling rate conversion, applications of multi-rate signal processing.

Pre-requisite: MEDE2201/ ELEC2201
Assessment: Please refer to the information provided by the Department of Electrical and Electronic Engineering

ELEC2205. 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.

Co-requisite: MEDE2201/ELEC2201
Assessment: Please refer to the information provided by the Department of Electrical and Electronic Engineering

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ELEC2302. Digital system design (6 credits)

This course aims at providing students the fundamental understanding of digital system structures and system design techniques using discrete and programmable devices. Digital system design as a synthesis process using building block components, and the electrical characteristics of basic gate components are discussed. The main issues in system interconnection are treated with major emphasis on design considerations for high-speed digital systems. Use of Hardware Description Language (HDL) for design is introduced. The analysis and synthesis of digital system structure, especially those related to circuit timing, data transfer, and data clocking are discussed. Various testing schemes for logic and memory testing are introduced. Simple stuck-at fault detection techniques and modern Design for Test (DFT) techniques are discussed.

Specifically this course covers the following topics in digital system design: Digital system concepts and digital components; digital design using discrete and programmable devices; high speed digital system design considerations; Hardware Description Language (HDL); design of digital system structures; digital logic and memory testing; fault detection analysis and design; Design for Test (DFT) techniques.

Pre-requisite: ENGG1008 / ELEC1306 / ELEC1401
Assessment: Please refer to the information provided by the Department of Electrical and Electronic Engineering

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ELEC2601. Human computer interaction (6 credits)

This course aims at providing fundamental knowledge on the principles of Human Computer Interaction (HCI): Design and Programming, and serves as the first course to other more advanced computer courses. In order to bring out the essential principles, a simple processor is used for illustration and is studied in detail, and on top of it, more general systems are also introduced.

Specifically, the course covers the following topics: human factors of interactive systems, design principles of user-interface, user conceptual models and interface metaphors, information and interactivity structures, interaction devices, presentation styles, information visualization; general features and components of window programming toolkits, event handling and layout management;

strategies for effective human-computer interaction, managing design process, evaluation of human-computer interaction.

Pre-requisite: ELEC1501 / ELEC1502 / ELEC1503 / CSIS0396
Assessment: Please refer to the information provided by the Department of Electrical and Electronic Engineering

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ELEC3222. Robotics (6 credits)

The development of robotics has evolved from early programmable industrial arms or manipulators (consisting of a driven mechanical structure) to a diverse range of objects that may generally be referred to as robots. As a result, robotics has become a highly interdisciplinary subject involving different kinds of technologies.

The first part of the course is aimed at providing a general understanding of the fundamental principles of robot manipulators covering robot kinematics, robot dynamics and robot control. The second part of the course will venture into selected topics in robotics (such as robot vision, AI in robotics etc.) and then consider robot applications to different areas (such as humanoid robot, medical and surgical robots, etc.).

At the end of the course, students should have gained an understanding in the principles and mathematical techniques that underlie the traditional manipulator as a basic building block of different kinds of robots, and also an appreciation of how other technologies can be applied to enhance the capabilities and scope of applications of robots.

Pre-requisite: ELEC2205
Assessment: Please refer to the information provided by the Department of Electrical and Electronic Engineering

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ELEC3225. Digital imaging processing (6 credits)

This course aims to help students gain a firm understanding in digital image processing and master its methods and techniques. It intends to build upon the knowledge students acquire in Signals and Linear Systems (ELEC2201) and extends it.

The course in general begins with the basics in 2D signals and systems, visual perception, image sensing and acquisition. It then proceeds to study various intensity transformations, histogram processing techniques, filters in both spatial and frequency domains, and how they can be used to enhance the quality of digital images. Next, it considers reconstruction and restoration of images due to degradations, how image quality is measured and color image processing. It then moves onto
Image compression, which plays a pivotal role today's Internet and multimedia applications. A core area of this course is to learn how to segment features/patterns from images. This includes using various methods to extract point, line, edge and regions. The course concludes by considering some typical image processing applications.

Specifically, it covers the areas of image acquisition and imaging systems, 2D continuous time and discrete time signals and systems, time and frequency representations, sampling and quantization issues, image filtering, convolution and enhancement, image reconstruction and restoration, color image processing, image quality evaluation, image transform and compression, applications and computer implementations.

Pre-requisite: MEDE2201/ ELEC2201
Mutually exclusive with: ELEC3505

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

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CSIS0278. Introduction to database management systems (6 credits)

This course studies the principles, design, administration, and implementation of database management systems. Topics include: entity-relationship model, relational model, relational algebra and calculus, database design and normalization, database query languages, indexing schemes, integrity, concurrency control, query processing. This course may not be taken with BUSI0052.

Prerequisite: ELEC1501
Assessment: Please refer to the information provided by the Department of Computer Science

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