

REGULATIONS FOR THE DEGREE OF MASTER OF SCIENCE IN ENGINEERING (MSc[Eng])

(See also General Regulations)

Any publication based on work approved for a higher degree should contain a reference to the effect that the work was submitted to the University of Hong Kong for the award of the degree.

The degree of Master of Science in Engineering (MSc[Eng]) is a postgraduate degree awarded for the satisfactory completion of a course of study in the Faculty of Engineering. The major part of the curriculum must be formed from modules offered in one of the following fields: building services engineering, communication engineering, computer and information technology, electrical and electronic engineering, environmental engineering, geotechnical engineering, electronic commerce, industrial engineering and industrial management, infrastructure project management, mechanical engineering, structural engineering, and transportation engineering. The MSc(Eng) is normally offered as a part-time programme. Some departments may offer a mode of study that enables a full-time candidate to complete in one year.

E12 Admission requirements

To be eligible for admission to the courses leading to the degree of Master of Science in Engineering, a candidate shall

- (a) comply with the General Regulations;
- (b) hold (1) a Bachelor's degree of this University in a relevant subject¹; or
 - (2) another relevant qualification of equivalent standard from this University or from another university or comparable institution accepted for this purpose; or
 - (3) a Postgraduate Diploma in Engineering (PDipEng) of this University in a relevant field²;
- (c) satisfy the examiners in a qualifying examination if required.

E13 Qualifying examination

- (a) A qualifying examination may be set to test the candidate's formal academic ability or his ability to follow the courses of study prescribed. It shall consist of one or more written papers or their equivalent and may include a project report.
- (b) A candidate who is required to satisfy the examiners in a qualifying examination shall not be permitted to register until he has satisfied the examiners in the examination.

¹ For MSc(Eng) in Building Services Engineering: engineering or related sciences.
 For MSc(Eng) in Communication Engineering or in Computer and Information Technology: physics, mathematics, or engineering
 For MSc(Eng) in Electrical and Electronic Engineering: physics, mathematics or engineering.
 For MSc(Eng) in Environmental Engineering: engineering or related sciences.
 For MSc(Eng) in Geotechnical Engineering: civil engineering.
 For MSc(Eng) in Industrial Engineering and Industrial Management: engineering or related sciences.
 For MSc(Eng) in Infrastructure Project Management: engineering.
 For MSc(Eng) in Mechanical Engineering: engineering, physical sciences or mathematics.
 For MSc(Eng) in Structural Engineering: civil engineering.
 For MSc(Eng) in Transportation Engineering: engineering or related sciences.

² Apply to students admitted to Postgraduate Diploma in Engineering in academic year 1998-99.

E14 Award of degree

- (a) To be eligible for the award of the degree of Master of Science in Engineering a candidate shall comply with the General Regulations; and complete the curriculum and satisfy the examiners in accordance with the regulations set out below.
 - (b) A candidate who has completed eight modules but has not satisfied the examiners for the award of the degree of Master of Science in Engineering may be awarded a PDipEng, subject to approval of the Faculty Board.
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E15 Length of curriculum

For the part-time mode of study, the curriculum shall extend over not less than two and not more than three academic years of study. For the full-time mode, the curriculum shall extend over not less than one and not more than two academic years of study. In both cases, a minimum of 300 hours of prescribed work are required.

E16 Completion of curriculum

- (a) To complete the curriculum a candidate shall, within the prescribed maximum period of study stipulated in Regulation E15 above:
 - (i) follow courses of instruction and complete satisfactorily all prescribed practical / laboratory work; and
 - (ii) shall either satisfy the examiners in either
 - (1) twelve modules at the prescribed written examinations; or
 - (2) eight modules and a project report or dissertation on a subject within his approved field of study.

The examiners may also prescribe an oral examination.

- (b) A candidate who fails to fulfill the requirements within the specified (i) three years for the part-time mode of study (ii) two years for the full-time mode shall be recommended for discontinuation under the provisions of General Regulation G12, except that a candidate, who is unable because of illness or circumstances beyond his control to complete the requirements within the prescribed maximum period of study, may apply for permission to extend his period of studies. Any such application shall be made within two weeks of the first day of the examination paper in question.
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E17 Course selection

- (a) Selection of study patterns shall be made in consultation with and be subject to the approval of the Head of the Department³ concerned.
- (b) A candidate who is permitted to select the study pattern under section (a)(ii)(1) of Regulation E16 shall select 12 modules which include a minimum of eight modules from the syllabuses of the candidate's approved field of study.
- (c) A candidate who is permitted to select the study pattern under section (a)(ii)(2) of Regulation E16 shall select eight modules which include a minimum of five modules from the syllabuses of the candidate's approved field of study. Full-time mode candidates must select this study pattern.

³ The Course Co-ordinator in respect of MSc(Eng) in Building Services Engineering and the Programme Director in MSc(Eng) in Internet Computing and in Electronic Commerce.

- (d) Subject to the approval of the Faculty Higher Degrees Committee on the recommendation of the Head of the Department³ concerned, a candidate may in exceptional circumstances be permitted to select an additional module.
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E18 Project report or dissertation

- (a) For part-time mode of study, a candidate shall submit the title of his project report or dissertation by a date specified by the Board of Examiners. A candidate may submit his completed project report or dissertation after the successful completion of four modules but shall not submit it later than the end of April of the third academic year of his studies unless special permission is granted for this period to be extended.
- (b) For the full-time mode of study, a candidate shall submit the title of his project or dissertation by a date specified by the Board of Examiners. A candidate must submit the completed project report or dissertation not later than the end of April of the second academic year of his studies unless special permission is granted for this period to be extended.
- (c) All candidates enrolled in any mode of study shall submit a statement that the project report or dissertation represents his own work (or in the case of conjoint work, a statement countersigned by his co-worker, which shows his share of the work) undertaken after the registration as a candidate for the degree.
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E19 Examinations

- (a) The written examination for each module shall be held after the completion of the prescribed course of study for that module, and not later than January or May immediately following the completion of the course of study for that module.
- (b) A candidate who has failed to satisfy the examiners in a module or modules may be permitted to present himself either for re-examination in the module or modules of failure or for examination in the same number of new modules when the examination is next held. To proceed to the following year of the curriculum, a candidate must satisfy the examiners in a minimum of two modules in each academic year. A candidate who passes in less than two modules in an academic year may be recommended for discontinuation of studies under the provisions of General Regulation G12.
- (c) A candidate who has presented an unsatisfactory project report or dissertation may be required to submit a revised project report or dissertation on the same subject within a specified period.
- (d) A candidate who has presented an unsatisfactory project report or dissertation for a second time shall be recommended for discontinuation of studies under the provisions of General Regulation G12.
- (e) A candidate who has failed to submit a satisfactory project report or dissertation within the prescribed maximum period of study, including any extension, shall be recommended for discontinuation of studies under the provisions of General Regulation G12.
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E20 Examination results

At the conclusion of the examination and after presentation of the project reports or dissertations, a pass list shall be published. A candidate who has shown exceptional merit or merit at the whole examination may be awarded a mark of distinction or credit, as appropriate, and this mark shall be recorded on the candidate's degree diploma.

SYLLABUSES FOR THE DEGREE OF MASTER OF SCIENCE IN ENGINEERING⁴**MSC(ENG) IN BUILDING SERVICES ENGINEERING**

The curriculum extends over not less than two and not more than three calendar years of study. It provides advanced education in the fields of design, management and operation of building services engineering systems.

The list below is not final and some courses may not be offered every year.

MEBS6000. Utility services

Cold and hot water supply: water distribution systems, patterns of usage, estimation of requirements, simultaneous demand, storage capacity, pumping arrangements, calorifiers and water heaters; steam systems: low and high pressure systems, boilers and heat exchangers, steam supply piping and condensate return, insulation, steam trapping; drainage systems and sewage disposal: stormwater and sanitary drainage systems, rainfall intensity, simultaneous sanitary discharge, sizing of drains and sewers, methods of sewage disposal, primary and secondary treatments; lifts, escalators and conveyors: lift traffic analysis, design calculation, electrical and mechanical features, code of practice; communication principles; communication systems; security and alarm systems.

MEBS6001. Electrical installations

Supply rules, standards and codes of practice; types of electrical systems; distribution in buildings; factory built assemblies; protective devices and safety interlocks; overcurrent and fault protection; installation design principles; protective earthing and equipotential bonding arrangements; standby generators; photovoltaics; uninterruptible power supplies; power factor correction and tariff; electrical safety; distribution transformers; switchgear and fuses; motor control gears; selection of electrical equipment and conductors; electromagnetic interference; lightning protection.

MEBS6002. Lighting engineering

Lighting physics; vision and light measurements; human perception; photometry and spectrophotometry; colorimetry; calculations of photometric data; glare control; guidelines for lighting design. Light production; artificial light sources and luminaires; daylighting; daylight factor; split flux formula; optical control; interior lighting; maintained illuminance; uniformity; colour rendering; utilization factors; polar curves; vector/scalar ratio; lighting for safety; lighting for workplaces; floodlighting; illuminance as vector; illuminance in complex situations.

MEBS6003. Project Management

Tendering procedure, contract documents and contract strategy, insurance; project planning, scheduling and control. Management and organization theory and practice; human resources development: motivation; leadership, organization structures, quality management; safety management; environmental issues; communication; disputes; delay analysis.

⁴ Candidates who have failed to satisfy the examiners for the Degree of M.Sc.(Eng.) may on termination of their study be awarded a Postgraduate Diploma in Engineering, subject to approval of the Faculty Board.

MEBS6004. Built environment

External environment: human factors, climatology; internal design criteria; thermal environment (heat): insulation for energy conservation, heat transmission, e.g. solar contribution; visual environment (light): eye and vision, light production, levels of illumination; aural environment (sound or noise): noise criteria for buildings, sources of noise and vibration, noise and vibration control; functional requirement of buildings.

MEBS6005. Building automation systems

Principles of building automation systems: system configurations; distributed processing and intelligence; types of input and output points; integrated control; direct digital control; energy, security and maintenance management. Microprocessor fundamentals: signal conditioning, processing and transmission; hardware and software development. Field devices; structured cabling; networking; interoperability; home automation. Current development; selection criteria; cost, reliability and system maintenance.

MEBS6006. Environmental services I

Different forms of energy supply to buildings: electricity, fuel oil, solar; heating and cooling systems: psychrometry, thermal comfort, heating and cooling load estimation, boilers, furnaces and other heating devices, associated equipment including piping, ducting work; refrigeration; air conditioning and ventilation: fresh air requirement, air contamination, fume and dust removal, air conditioning system design, control devices.

MEBS6008. Environmental services II

Fans and pumps: types and characteristics, parallel and series operation, system effects; complex fluid network analysis: graphical and iterative methods of solution, application to air and water systems and analysis of building air infiltration; room air diffusion: design strategies, application of computational fluid dynamics; sea water cooling systems: design and operation, water treatment; thermal storage systems: applications, system design and economic analysis; acoustic treatment and vibration isolation: basic principles, need for control, types and methods of control.

MEBS6009. Fire services design (2 modules)

Characteristics and behaviour of fire, fire hazards of materials and buildings, fire hazards of building services and processes; smoke production and properties, smoke management principles, zone smoke control, smoke extraction and smoke vent design, staircase pressurisation, design and computational analysis; legal aspects of fire safety management and statutory regulations – COP, LPC rules and N.F.P.A. codes; fire protection strategies, architectural and structural designs, means of escape, fire detection and alarm systems, water-based fire extinguishing systems, gas-based fire extinguishing systems, special building facilities for fire safety; fire protection and design principles for special hazardous areas; hydraulic analysis; performance-based fire codes and approaches, installation and commissioning; maintenance requirements.

MEBS6010. Indoor air quality

Concept of indoor air quality, health requirements, sick building syndrome, building related illnesses, indoor air quality indicators, types, sources, characterization and health effects of pollutants, concentration, individual and population exposure, dose-response relationships, measurement and monitoring methods, ventilation, filtration, indoor air quality assessment and control, operation and maintenance, legislation and public policy issues, energy and cost implications.

MEBS6011. Maintenance and management of building facilities

Areas of facilities management; security of facilities; strategies and philosophies of maintenance; optimum control and operation; fault detection and analysis; building pathology; energy management; safety and environmental maintenance. Operational techniques in maintenance: decision making techniques; spares inventory control; resource management; computerized maintenance; measures of maintenance effectiveness. Plant availability, maintainability and reliability.

MEBS6012. Project (4 modules)**MEBS6013. Testing and commissioning**

The commissioning process: design provisions, specification, documentation, planning and management, contractual responsibilities; setting to work; measurement methods: fundamentals, instrumentation, calibration, methodology, sources of error; commissioning tests on electrical and mechanical plants; balancing of fluid networks; performance testing; post construction evaluation.

MEBS6014. Computer modelling and simulation

Mathematical modelling: modelling of systems; subsystems and components, deterministic and stochastic modelling, steady-state and dynamic modelling, model format, accuracy and validation, applications to thermofluid systems for design, performance evaluation and economic analysis.

Computer simulation: computer implementation of simulation models, simulation methods by successive substitution and Newton-Raphson approach for univariate and multivariate problems, steady-state simulations for system analysis at off-design conditions, dynamic simulations for transient analysis, techniques for simulation of large systems and use of modular computer simulation packages.

MEBS6015. Natural and hybrid ventilation of buildings

Concepts of natural ventilation and hybrid ventilation, mixed-mode air conditioning, purposes of natural ventilation, driving forces, natural ventilation strategies for simple and complex buildings, design methods and guidelines, wind tunnel and small-scale testing, design processes and life-cycle analyses.

MEBS6016. Energy performance of buildings

Energy terms and concepts; energy use in buildings; energy efficient building design and operation; energy efficient technologies; building energy standards and codes; building energy analysis techniques; energy auditing of buildings; economic and financial analyses.

MEBS6017. Building intelligence

Fundamental concepts of intelligent building systems; whole building intelligence; evaluation of building intelligence; needs of occupants, cost effectiveness, economic benefits; engineering intelligence into buildings; information technology; building energy management and control systems; intelligent building design; intelligent controls; expert systems, artificial neural networks, genetic algorithms, fuzzy logic; potential and direction of future developments.

MSC(ENG) IN COMMUNICATION ENGINEERING**Core Courses**

Each candidate is required to follow a prescribed course of study consisting of 12 modules for getting a master degree. At least six of the 12 modules have to be selected from the list of **Core Courses**. Students can also select to undertake a project and eight modules of which five have to be selected from the list of **Core Courses**. The list below is not final and some courses may not be offered every year. Candidate will be required to do the coursework in the respective courses selected. The course code and course titles for the **Core Courses** are listed as follows.

ELEC7005	DSP applications in communications
ELEC6006	Communications policy and regulations
ELEC6014	Digital communications I
ELEC6026	Digital signal processing I
ELEC6030	Speech analysis and processing
ELEC6040	Mobile radio communications
ELEC6043	Digital image processing
ELEC7144	Advanced Internet infrastructure technologies
ELEC6045	Digital communications II
ELEC7051	Advanced topics in communication theory and systems
ELEC6063	Optoelectronics and lightwave technology
ELEC6065	Data compression
ELEC6069	Multimedia storage systems
ELEC6071	Wireless networking
ELEC7073	Digital communications III
ELEC6074	Stochastic processes
ELEC7002	Digital signal processing II
ELEC7076	Space time wireless communications

The non-core courses can be selected from the list of MSc courses in the Department of Electrical and Electronic Engineering and some of the MSc courses in the Department of Computer Science, or from the MSc courses offered by other departments of the Faculty of Engineering subject to approval.

SYLLABUSES FOR THE CORE COURSES**ELEC6006. Communications policy and regulations**

Radio frequency management, allocation of spectrum, regulations for spectrum use, common carriers, Satellite and cables, competition and compliance, ITU, long term policy planning.

ELEC6014. Digital communications I

Basics of stochastic processes; source coding; characterizations of signals; AWGN channels; channel capacity; modulation and demodulation; synchronization; equalization.

ELEC6021. Project (4 modules)**ELEC6026. Digital signal processing I**

One and two dimensional discrete-time signals and systems; analysis and design of digital filters, implementation issues; waveform coding; spectral analysis; adaptive signal processing; multirate signal processing; signal processing algorithms and system architecture; applications of digital signal processing.

ELEC6030. Speech analysis and processing

Models for speech signals; coding and storage of speech; short-time frequency domain techniques; linear predictive coding; speech synthesis; speech recognition; application case studies.

ELEC6040. Mobile radio communications

Introduction to mobile radio communications; statistical communication theory; elements of mobile radio communication systems; error performance over radio links; cellular systems; elements of cellular systems design; the digital cellular systems and the future systems.

ELEC6043. Digital image processing

Properties and descriptions of digital images; image formation, sampling, time and frequency representations; wavelets; image enhancement, restoration, filters, and edge detection; human visual system, color, and sensors; binary image processing and morphological filters; coding and compression.

Prerequisite: Exposure to signals and systems at the level of ELEC2201

ELEC6045. Digital communications II

Introduction; direct sequence; frequency/time hopping and hybrid systems; characteristics, anti-jam, multiple access; generation and detection of spread spectrum signals; applications to secure communications, digital cellular mobile systems.

ELEC6063. Optoelectronics and lightwave technology

Optical materials engineering, optical devices – waveguide/switches, lasers and LED, and optoelectronic IC, photonic switching systems – super capacity/speed, and multi-media technology applications – ATM and broadband ISDN.

ELEC6065. Data compression

Lossless compression, image compression, video compression, audio compression, coding standards.

ELEC6069. Multimedia storage systems

Basic characteristics of multimedia data, compression standards, storage organizations, disk scheduling, data migration, and cache replacement.

ELEC6071. Wireless networking

Overview of existing wireless networking services and technologies; requirements and challenges for mobile data network design; access technologies; short-range wireless technologies: Bluetooth, IEEE 802.11x WLAN, and coexistence issues; mobility management; protocol adaptations for wireless networking: Mobile IP, WAP, TCP over wireless; wireless resources management: packet scheduling, power management, ad hoc routing; mobile data network security; emerging mobile data architectures and services; mobile data application issues: wireless cache invalidation, wireless video, location dependent services.

Prerequisite: ELEC2402 Computer communications or CSIS0234 Computer and communication networks (for undergraduate students only)

ELEC6074. Stochastic processes

General concept; random walks and other applications; spectral representation; entropy; spectrum estimation; Markov chains; selected topics.

ELEC7002. Digital signal processing II

Multirate signal processing: polyphase components, sampling rate converters, filterbanks and wavelets, applications. Introduction to detection and estimation theory: Neyman-Pearson and Bayes theory, maximum-likelihood and Bayesian estimation, applications. Optimal filtering: Kalman, Wiener, and adaptive filters, applications.

ELEC7005. DSP applications in communications

Source coding techniques: signal decorrelation, quantization, entropy coding; Image, video, audio and speech coding. Adaptive Filtering Algorithms and Applications: adaptive filtering algorithms, channel equalization, echo cancellation. Implementation of digital signal processing algorithms.

ELEC7051. Advanced topics in communication theory and systems

This course aims at offering an in-depth view of some research topics of current interest in the field of communication theory and systems.

ELEC7073. Digital communications III

Introduction, adaptive modulation, channel coding, digital communications through fading multipath channels, ARQ.

ELEC7076. Space time wireless communications

Multiuser detection and MAI structure; Space time channel models: SIMO, MISO, MIMO; signal and interference models; capacity of space time channels; space time coding; spatial multiplexing; diversity; beam-forming; smart antennas.

ELEC7144. Advanced Internet infrastructure technologies

Web caching and load balancing; contents distribution networks (CDNs); Multimedia networking: streaming, RTSP, RTP, RTCP, H.323, session management and conference control; buffer design; traffic shaping; Internet QoS: IntServ, DiffServ, packet scheduling, RSVP, MPLS, GMPLS; multicasting: addressing, multicast routing, reliable multicast transport; Peer-to-peer protocols; grid computing protocols.

MSC(ENG) IN COMPUTER AND INFORMATION TECHNOLOGY**Core Courses**

Each candidate is required to follow a prescribed course of study consisting of 12 modules for getting a master degree. At least six of the 12 modules have to be selected from the list of **Core Courses**. Students can also select to undertake a project and eight modules of which five have to be selected from the list of **Core Courses**. The list below is not final and some courses may not be offered every year. Candidate will be required to do the coursework in the respective courses selected. The course code and course titles for the **Core Courses** are listed as follows.

ELEC6007	Internet protocols and services
ELEC6008	Pattern recognition
ELEC6031	Numerical methods for computer applications
ELEC6036	High-performance computer architecture
ELEC6040	Mobile radio communications
ELEC6043	Digital image processing
ELEC6048	Neural computing
ELEC7101	Quantum computing II
ELEC7150	Advanced topics in computer engineering and networking
ELEC7162	Scalable parallel computing
ELEC6065	Data compression
ELEC6069	Multimedia storage systems
ELEC6070	Cryptography and network security
ELEC6071	Wireless networking
ELEC6101	Quantum computing I
ELEC6102	Reconfigurable embedded computing systems
CSIS7302	Embedded system and pervasive computing

The non-core courses can be selected from the list of MSc courses in the Department of Electrical and Electronic Engineering and some of the MSc courses in the Department of Computer Science, or from the MSc courses offered by other departments of the Faculty of Engineering subject to approval.

SYLLABUSES FOR THE CORE COURSES

ELEC6007. Internet protocols and services

Fundamentals of computer networking; performance metrics; Internet backbone and access technologies; link-layer and LANs; bridge protocols; network layer and routing; IP addressing; transport layer and TCP; congestion control; UDP; application layer and WWW; HTTP; network services: SMTP and sendmail, DNS and BIND, network management and SNMP; introduction to secure protocols: IPSec, SSL, and TLS.

ELEC6008. Pattern recognition

Bayes decision theory; parametric and non-parametric techniques; linear discriminant functions; unsupervised training and clustering; feature extraction; neural network techniques; structural recognition techniques; miscellaneous methods and applications.

ELEC6021. Project (4 modules)

ELEC6031. Numerical methods for computer applications

General principles of computer application; accuracy and error analysis; series and functions; linear algebra; nonlinear equations; finite differences applied to interpolation, integration and differentiation; special topics in optimization, Monte Carlo method or Fourier methods.

ELEC6036. High-performance computer architecture

Introduction to high-performance model processors; pipelining and instruction-level parallelism; advanced pipelining design: scoreboard and Tomasulo algorithm; speculative execution (branch prediction supported by reorder buffers); advanced technologies: value prediction, instruction reuse; advanced computing model: quantum computing; low-power processor design (e.g., Transmeta's Crusoe processors); case studies (e.g., IA-64).

Prerequisite: ELEC1623 Computer micro-architecture and system software interfacing or ELEC2401 Computer architecture (for undergraduate students only)

ELEC6040. Mobile radio communications

Introduction to mobile radio communications; statistical communication theory; elements of mobile radio communication systems; error performance over radio links; cellular systems; elements of cellular systems design; the digital cellular systems and the future systems.

ELEC6043. Digital image processing

Properties and descriptions of digital images; image formation, sampling, time and frequency representations; wavelets; image enhancement, restoration, filters, and edge detection; human visual system, color, and sensors; binary image processing and morphological filters; coding and compression.

Prerequisite: Exposure to signals and systems at the level of ELEC2201

ELEC6048. Neural computing

Conventional statistical pattern recognition: Bayes decision theory; basic neural network: the perceptron, iterative learning; networks with hidden layers: decision regions, backpropagation learning, convergence and speeding up algorithms; other models: the radial basis function network, the ART network, the self-organizing neural map, etc.; applications: speech and pattern recognition, functional approximation; VLSI and optical implementation.

ELEC6065. Data compression

Lossless compression, image compression, video compression, audio compression, coding standards.

ELEC6069. Multimedia storage systems

Basic characteristics of multimedia data, compression standards, storage organizations, disk scheduling, data migration, and cache replacement.

ELEC6070. Cryptography and network security

This course focuses on the mathematical concepts and techniques behind the state-of-the-art information encryption and network security technologies. Also covered are the security threats and their possible countermeasures, secure protocols, and other network security related schemes (authentication, key management, etc.).

Prerequisite: ELEC2701 Internet technologies and applications or CSIS0234 Computer and communication networks (for undergraduate students only)

ELEC6071. Wireless networking

Overview of existing wireless networking services and technologies; requirements and challenges for mobile data network design; access technologies; short-range wireless technologies: Bluetooth, IEEE 802.11x WLAN, and coexistence issues; mobility management; protocol adaptations for wireless networking: Mobile IP, WAP, TCP over wireless; wireless resources management: packet scheduling, power management, ad hoc routing; mobile data network security; emerging mobile data architectures and services; mobile data application issues: wireless cache invalidation, wireless video, location dependent services.

Prerequisite: ELEC2402 Computer communications or CSIS0234 Computer and communication networks (for undergraduate students only)

ELEC6101. Quantum computing I

Schrodinger's equation; the harmonic oscillator; photon polarization states, analysis and recombination of polarized beams; quantum amplitudes and state vectors, path amplitudes; time evolution of quantum states, moving packet states; state vectors as vectors in Hilbert space, self-adjoint operators, projection operators; mathematical formalism: observables and measurements; electron spin and Pauli matrices; pure and mixed states, density matrices, time evolution of density matrices; quantum entanglement; quantum states of composite systems, Schmidt decomposition, measurements on only one part of a system.

ELEC6102. Reconfigurable embedded computing systems

Overview of application-level parallelism; Overview of reconfigurable hardware; Reconfigurable field-programmable gate array (FPGA) systems; FPGA placement and routing; FPGA system design; Co-processing approaches; Dynamic reconfiguration; Reconfiguration algorithms; Embedded operating systems (e.g., Linux); Hardware/software co-design; Applications in signal processing and data security;

Prerequisite: ELEC6036 High performance computer architectures, and knowledge of VHDL or Verilog HDL

ELEC7101. Quantum computing II

Review of quantum entanglement and quantum states of composite systems; the EPR paradox; quantum information, teleportation; cryptology; quantum gates; quantum computing algorithms: Deutsch's algorithm, Simon's algorithm, Shor's factorization algorithm, Grover's search algorithm; the decoherence problem; quantum error correction; fault-tolerant quantum computation.

ELEC7150. Advanced topics in computer engineering and networking

This course aims at offering an in-depth view of some research topics of current interest in the field of computer engineering and networking.

ELEC7162. Scalable parallel computing

Commodity microprocessors, high-performance networks, symmetric multi-processor, clusters of PC/workstations, massively parallel processors, scientific and commercial applications, distributed multi-media and scalable computing.

CSIS7302. Embedded system and pervasive computing

The course offers practical knowledge needed in embedded system development. Industry and research projects will be discussed to show how human life can be benefited from pervasive computing. Topics include wearable computer architecture and applications; sensor networks; real-time embedded operating systems; embedded servers; embedded system networking; address-free routing; smart spaces; dynamic service discovery; mobility and case studies.

MSC(ENG) IN ELECTRICAL AND ELECTRONIC ENGINEERING

The Master of Science in Electrical and Electronic Engineering Programme, based on six study fields of advanced technologies, has three different streams: General Stream, Communications Engineering, and Computer and Information Engineering. Each candidate is required to follow a prescribed course of study comprising 12 modules, out of which the candidate has to pass at least 8 modules selected from the EEE Department. To qualify as a graduate of the Communications Engineering Stream, the candidate must pass at least 6 modules in the Communications Engineering study field. To qualify as a graduate of the Computer and Information Engineering Stream, the candidate must pass at least 6 modules in the Computer Engineering and Networking study field. For the General Stream of study, there is no restriction about course selections within the EEE Department. Subject to approval, candidates can select to undertake a project (ELEC6021) and in which case, General Stream candidates are required to pass at least 5 modules selected from the EEE Department, while Communications Engineering and Computer and Information Engineering Streams candidates are still required to pass at least 6 modules in their respective study fields.

The Six Study Fields

A. Communications Engineering

ELEC6006	Communications policy and regulations
ELEC6014	Digital communications I
ELEC6026	Digital signal processing I
ELEC6030	Speech analysis and processing
ELEC6040	Mobile radio communications
ELEC6045	Digital communications II
ELEC6071	Wireless networking
ELEC7002	Digital signal processing II
ELEC7005	DSP applications in communications
ELEC7051	Advanced topics in communication theory and systems
ELEC7072	Advanced wireless transceiver design
ELEC7073	Digital communications III
ELEC7076	Space time wireless communications

B. Computer Engineering and Networking

ELEC6007	Internet protocols and services
ELEC6036	High performance computer architecture
ELEC6043	Digital image processing
ELEC6048	Neural computing
ELEC6049	Digital system design techniques
ELEC6065	Data compression
ELEC6069	Multimedia storage systems
ELEC6070	Cryptography and network security
ELEC6101	Quantum computing I
ELEC6102	Reconfigurable embedded computing systems
ELEC7101	Quantum computing II
ELEC7141	Advanced image processing and machine vision
ELEC7144	Advanced Internet infrastructure technologies
ELEC7150	Advanced topics in computer engineering and networking
ELEC7162	Scalable parallel computing

C. Control Systems and Biomedical Engineering

ELEC6008	Pattern recognition
ELEC6025	Industrial digital control
ELEC6028	Robotics
ELEC6034	System identification and estimation
ELEC6046	Intelligent control
ELEC6053	Biomedical electronics and sensors systems
ELEC6067	Magnetic resonance imaging (MRI) technology and applications
ELEC7247	Advanced control theory
ELEC7252	Advanced topics in control theory and systems

D. Electronics

ELEC6027	Integrated circuit systems design
ELEC6032	Process and device design for VLSI circuits
ELEC6042	VLSI physical design automation
ELEC6063	Optoelectronics and lightwave technology
ELEC6075	Principles of microlithography
ELEC7364	Advanced topics in microelectronics
ELEC7368	Advanced digital integrated circuit design

E. Power Systems

ELEC6004	Railway engineering and applications
ELEC6054	Power system dynamics
ELEC6055	Power system distribution
ELEC6057	Power system planning
ELEC6058	Power transmission
ELEC7401	Advanced topics in electric drives and control
ELEC7402	Advanced electric vehicle technology
ELEC7403	Advanced power electronics
ELEC7456	Advanced power system operation
ELEC7466	Advanced topics in power system engineering

F. Mathematical Techniques

ELEC6031	Numerical methods for computer applications
ELEC6074	Stochastic Processes
ELEC6501	The Fourier transform and its applications
ELEC7501	Optimization techniques

The list below is not final and some courses may not be offered every year.

ELEC6004. Railway engineering and applications

Selected topics from recent developments in areas of signalling, train control and protection systems, AC and DC traction systems, AC and DC electrification systems, train performance modeling and simulation, electromagnetic compatibility disturbance sources and susceptibility, auxiliary power supplies, installing and commissioning, and related areas.

ELEC6006. Communications policy and regulations

Radio frequency management, allocation of spectrum, regulations for spectrum use, common carriers, Satellite and cables, competition and compliance, ITU, long term policy planning.

ELEC6007. Internet protocols and services

Fundamentals of computer networking; performance metrics; Internet backbone and access technologies; link-layer and LANs; bridge protocols; network layer and routing; IP addressing; transport layer and TCP; congestion control; UDP; application layer and WWW; HTTP; network services: SMTP and sendmail, DNS and BIND, network management and SNMP; introduction to secure protocols: IPSec, SSL, and TLS.

ELEC6008. Pattern recognition

Bayes decision theory; parametric and non-parametric techniques; linear discriminant functions; unsupervised training and clustering; feature extraction; neural network techniques; structural recognition techniques; miscellaneous methods and applications.

ELEC6014. Digital communications I

Basics of stochastic processes; source coding; characterizations of signals; AWGN channels; channel capacity; modulation and demodulation; synchronization; equalization.

ELEC6021. Project (4 modules)**ELEC6025. Industrial digital control**

Microcomputer control. Discrete modelling. System analysis. Conventional and optimal controller design. Parameter and state estimation. Adaptive control principles. Micro-controller implementation.

ELEC6026. Digital signal processing I

One and two dimensional discrete-time signals and systems; analysis and design of digital filters, implementation issues; waveform coding; spectral analysis; adaptive signal processing; multirate signal processing; signal processing algorithms and system architecture; applications of digital signal processing.

ELEC6027. Integrated circuit systems design

IC design route and technology considerations; logic and circuit design with MOS and CMOS: data and control flow in systematic structures; systems design and design methods; computer aids to IC design; application case studies.

ELEC6028. Robotics

Robot types; manipulator mechanism and kinematics; actuators; sensors; control; robot programming and application case studies.

ELEC6030. Speech analysis and processing

Models for speech signals; coding and storage of speech; short-time frequency domain techniques; linear predictive coding; speech synthesis; speech recognition; application case studies.

ELEC6031. Numerical methods for computer applications

General principles of computer application; accuracy and error analysis; series and functions; linear algebra; nonlinear equations; finite differences applied to interpolation, integration and differentiation; special topics in optimization, Monte Carlo method or Fourier methods.

ELEC6032. Process and device design for VLSI circuits

Design of submicron MOS and bipolar devices; scaling schemes and their related problems; introduction to process and device simulation tools; capabilities and limitations; methodology in process and device developments; case study of a typical IC process; advanced IC technologies.

ELEC6034. System identification and estimation

Nonparametric time-domain and frequency-domain methods; correlation and spectral analysis; periodogram; lag windows. Parameter estimation methods. Linear regression; least-squares estimation. Auto regressive moving average models. Prediction error methods; maximum likelihood. Instrumental variable methods. Recursive identification methods. Real-time identification. Extended Kalman filter. Design of identification experiments; choice of input signal and sampling interval. Identification of systems in closed-loop operation. Model validation and model structure determination. Applications and case studies.

ELEC6036. High-performance computer architecture

Introduction to high-performance model processors; pipelining and instruction-level parallelism; advanced pipelining design: scoreboard and Tomasulo algorithm; speculative execution (branch prediction supported by reorder buffers); advanced technologies: value prediction, instruction reuse; advanced computing model: quantum computing; low-power processor design (e.g., Transmeta's Crusoe processors); case studies (e.g., IA-64).

Prerequisite: ELEC1623 Computer micro-architecture and system software interfacing or ELEC2401 Computer architecture (for undergraduate students only)

ELEC6040. Mobile radio communications

Introduction to mobile radio communications; statistical communication theory; elements of mobile radio communication systems; error performance over radio links; cellular systems; elements of cellular systems design; the digital cellular systems and the future systems.

ELEC6042. VLSI physical design automation

Physical VLSI design methodologies; design rule verification, layout compaction; automatic placement and routing; floor-planning and parallel algorithms.

ELEC6043. Digital image processing

Properties and descriptions of digital images; image formation, sampling, time and frequency representations; wavelets; image enhancement, restoration, filters, and edge detection; human visual system, color, and sensors; binary image processing and morphological filters; coding and compression.

Prerequisite: Exposure to signals and systems at the level of ELEC2201

ELEC6045. Digital communications II

Introduction; direct sequence; frequency/time hopping and hybrid systems; characteristics, anti-jam, multiple access; generation and detection of spread spectrum signals; applications to secure communications, digital cellular mobile systems.

ELEC6046. Intelligent control

Introduction to AI and expert systems; foundations of knowledge engineering; knowledge representation knowledge-based control; intelligent control systems; real-time control issues.

ELEC6048. Neural computing

Conventional statistical pattern recognition: Bayes decision theory; basic neural network: the perceptron, iterative learning; networks with hidden layers: decision regions, backpropagation learning, convergence and speeding up algorithms; other models: the radial basis function network, the ART network, the self-organizing neural map, etc.; applications: speech and pattern recognition, functional approximation; VLSI and optical implementation.

ELEC6049. Digital system design techniques

VHDL and hardware description language; mixed-level and mixed-mode simulation techniques; logic and system synthesis; testing, fault analysis and grading, design for testability; programmable logic devices and applications; high speed digital system design.

ELEC6053. Biomedical electronics and sensors systems

Biomedical technology, sensing, signal processing, control and computation. Physiological and anatomic aspects of medical monitoring and imaging.

ELEC6054. Power system dynamics

Synchronous machine modelling; load models; small-signal stability; transient stability; voltage stability; subsynchronous resonance; mid-term and long-term stability; numerical methods, direct methods, methods of improving stability.

ELEC6055. Power system distribution

Substation configuration and design; feeder design fault detection and isolation; restoration; voltage regulation; secondary circuit design; distribution system reliability analysis; distribution automation.

ELEC6057. Power system planning

Optimal generation expansion; load forecasting; reliability evaluation; probabilistic production costing, Monte Carlo simulation; value of service; least cost planning; electricity pricing.

ELEC6058. Power transmission

High voltage a.c. transmission. Steady-state and transient performance of transmission lines. System simulation. Lightning performance. Overvoltages and insulation coordination. Reactive power control, SVC's, Field effects, corona, radio interference and noise. High voltage d.c. transmission. Thyristor valves, converter operation, harmonics and filters, protection and insulation coordination.

ELEC6063. Optoelectronics and lightwave technology

Optical materials engineering, optical devices - waveguide/switches, lasers and LED, and optoelectronic IC, photonic switching & optical communications systems.

ELEC6065. Data compression

Lossless compression, image compression, video compression, audio compression, coding standards.

ELEC6067. Magnetic resonance imaging (MRI) technology and applications

Fundamentals of Nuclear Magnetic Resonance (NMR); introduction to MR imaging system; design principle of permanent and super-conducting magnets; RF antennas (probes), gradient coils, RF transmitter and receivers; signal processing and imaging reconstruction; basic pulse sequence design; advanced fast imaging methods; MR spectroscopy and MR imaging applications, including functional MRI in human brain functional research and clinical applications.

ELEC6069. Multimedia storage systems

Basic characteristics of multimedia data, compression standards, storage organizations, disk scheduling, data migration, and cache replacement.

ELEC6070. Cryptography and network security

This course focuses on the mathematical concepts and techniques behind the state-of-the-art information encryption and network security technologies. Also covered are the security threats and their possible countermeasures, secure protocols, and other network security related schemes (authentication, key management, etc.).

Prerequisite: ELEC2701 Internet technologies and applications or CSIS0234 Computer and communication networks (for undergraduate students only)

ELEC6071. Wireless networking

Overview of existing wireless networking services and technologies; requirements and challenges for mobile data network design; access technologies; short-range wireless technologies: Bluetooth, IEEE 802.11x WLAN, and coexistence issues; mobility management; protocol adaptations for wireless networking: Mobile IP, WAP, TCP over wireless; wireless resources management: packet scheduling, power management, ad hoc routing; mobile data network security; emerging mobile data architectures and services; mobile data application issues: wireless cache invalidation, wireless video, location dependent services.

Prerequisite: ELEC2402 Computer communications or CSIS0234 Computer and communication networks (for undergraduate students only)

ELEC6074. Stochastic processes

General concept; random walks and other applications; spectral representation; entropy; spectrum estimation; Markov chains; selected topics.

ELEC6075. Principles of microlithography

Optical imaging and resolution; modified illumination; optical proximity correction; phase-shifting mask; second-generation resolution enhancement techniques.

ELEC6101. Quantum computing I

Schrodinger's equation; the harmonic oscillator; photon polarization states, analysis and recombination of polarized beams; quantum amplitudes and state vectors, path amplitudes; time evolution of quantum states, moving packet states; state vectors as vectors in Hilbert space, self-adjoint operators, projection operators; mathematical formalism: observables and measurements; electron spin and Pauli matrices; pure and mixed states, density matrices, time evolution of density matrices; quantum entanglement; quantum states of composite systems, Schmidt decomposition, measurements on only one part of a system.

ELEC6102. Reconfigurable embedded computing systems

Overview of application-level parallelism; Overview of reconfigurable hardware; Reconfigurable field-programmable gate array (FPGA) systems; FPGA placement and routing; FPGA system design; Co-processing approaches; Dynamic reconfiguration; Reconfiguration algorithms; Embedded operating systems (e.g., Linux); Hardware/software co-design; Applications in signal processing and data security;

Prerequisite: ELEC6036 High performance computer architectures, and knowledge of VHDL or Verilog HDL

ELEC6501. The Fourier transform and its applications

The Fourier transform as a tool for solving physical problems. Fourier transform of discrete and continuous time signals, generalized transforms, and Fourier series. Convolutions and correlations, impulses and sampling, Fourier transform theorems, and analysis of linear systems. Two-dimensional imaging, Hankel and Abel transforms. Time-frequency localization and introduction to wavelets. Applications in communications, image processing, and medical imaging.

Prerequisite: Prior exposure to Fourier transforms at the level of ELEC2201.

ELEC7002. Digital signal processing II

Multirate signal processing: polyphase components, sampling rate converters, filterbanks and wavelets, applications. Introduction to detection and estimation theory: Neyman-Pearson and Bayes theory, maximum-likelihood and Bayesian estimation, applications. Optimal filtering: Kalman, Wiener, and adaptive filters, applications.

ELEC7005. DSP applications in communications

Source coding techniques: signal decorrelation, quantization, entropy coding; Image, video, audio and speech coding. Adaptive Filtering Algorithms and Applications: adaptive filtering algorithms, channel equalization, echo cancellation. Implementation of digital signal processing algorithms.

ELEC7051. Advanced topics in communication theory and systems

This course aims at offering an in-depth view of some research topics of current interest in the field of communication theory and systems.

ELEC7072. Advanced wireless transceiver design

An advanced course focus on the algorithms and designs of wireless transmitter and receiver. Theoretical background and practical algorithms will be introduced. The course is divided into two parts, namely the transmitter design and receiver design. On the transmitter part, we shall give some background review on the concept of signal space and signal dimension and will focus on channel models, baseband transmission, passband transmission, Shannon's coding theorem, forward error correction coding, modulation techniques and signal constellations [transmission for high bandwidth efficiency, transmission for high bandwidth expansion], peak-to-average ratio considerations; On the receiver design part, we shall focus on demodulation and decoding techniques, channel estimation and equalization, synchronization and timing recovery; Finally, we shall illustrate the concept by considering practical UMTS or Wireless LAN transceiver designs as examples. Students taking this course should be aware of the required pre-requisites and the advanced nature of the course.

Pre-requisites: (ELEC6014 or ELEC7073 or ELEC3201) and (ELEC6040 or ELEC6045 or ELEC3207 or ELEC3203)

ELEC7073. Digital communications III

Introduction, adaptive modulation, channel coding, digital communications through fading multipath channels, ARQ.

ELEC7076. Space time wireless communications

Multiuser detection and MAI structure; Space time channel models: SIMO, MISO, MIMO; signal and interference models; capacity of space time channels; space time coding; spatial multiplexing; diversity; beam-forming; smart antennas.

ELEC7101. Quantum computing II

Review of quantum entanglement and quantum states of composite systems; the EPR paradox; quantum information, teleportation; cryptology; quantum gates; quantum computing algorithms: Deutsch's algorithm, Simon's algorithm, Shor's factorization algorithm, Grover's search algorithm; the decoherence problem; quantum error correction; fault-tolerant quantum computation.

ELEC7141. Advanced image processing and machine vision

2D and 3D image acquisition and optical systems; imaging with coherent and incoherent light; optical transfer functions, modulation transfer functions, and aberrations; image restoration, reconstruction, and super-resolution; holography; image feature extraction and inspection systems; denoising; image segmentation and mathematical morphology.

Prerequisite: Prior experience in image processing at the level of ELEC3504 or ELEC6043.

ELEC7144. Advanced Internet infrastructure technologies

Web caching and load balancing; contents distribution networks (CDNs); Multimedia networking: streaming, RTSP, RTP, RTCP, H.323, session management and conference control; buffer design; traffic shaping; Internet QoS: IntServ, DiffServ, packet scheduling, RSVP, MPLS, GMPLS; multicasting: addressing, multicast routing, reliable multicast transport; Peer-to-peer protocols; grid computing protocols.

ELEC7150. Advanced topics in computer engineering and networking

This course aims at offering an in-depth view of some research topics of current interest in the field of computer engineering and networking.

ELEC7162. Scalable parallel computing

Commodity microprocessors, high-performance networks, symmetric multi-processor, clusters of PC/workstations, massively parallel processors, scientific and commercial applications, distributed multi-media and scalable computing.

ELEC7247. Advanced control theory

Dynamic systems; linear system theory; controller design methodologies; stability analysis; performance analysis; robust control; filtering theory; adaptive systems.

ELEC7252. Advanced topics in control theory and systems

This course aims at offering an in-depth view of some research topics of current interest in the field of control theory and systems.

ELEC7364. Advanced topics in microelectronics

This course aims at offering an in-depth view of some research topics of current interest in the field of microelectronics.

ELEC7368. Advanced digital integrated circuit design

Multiple levels of abstraction, simulation, synthesis, verification, computer-aided design.

ELEC7401. Advanced topics in electric drives and control

Selected topics from the latest development in the areas of electric drives and control.

ELEC7402. Advanced electric vehicle technology

Selected topics from the latest development in the areas of electric vehicle technology.

ELEC7403. Advanced power electronics

High Frequency switching converters. Dynamics and Control of switching converters. Modelling of switching converters. Components and devices. Industrial requirements.

ELEC7456. Advanced power system operation

The course is to teach advanced operation and control theory and methodology used in the energy management system of modern power systems, including economic dispatch, automatic generation control, unit commitment, hydro-thermal power coordination, state estimation, security assessment, optimal power flow and power system deregulation.

ELEC7466. Advanced topics in power system engineering

To study specific topics and issues of special current interest in power system engineering.

ELEC7501. Optimization techniques

Basic concept: classification of optimization problems. Linear programming: duality and solution methods. Unconstrained optimization: optimality conditions and solution methods. Constrained optimization: Equality and Inequality constraints, Lagrange multiplier method and Kuhn-Tucker conditions, Solution methods. Dynamic programming. Convex optimizations. Applications.

MSC(ENG) IN ELECTRONIC COMMERCE⁵

For the part-time mode, the curriculum shall normally take two calendar years of study. It provides an understanding of the use of Internet technologies to globalize business opportunities and operations.

A candidate shall study 8 modules (of one module each) and a Project (of 4 modules) or 12 modules. A minimum of 5 modules shall be from the list below, and not more than 3 modules may be from the syllabuses for MSc(Eng) Internet computing if candidates opt for taking 8 modules and a Project. A minimum of 8 modules shall be from the list below, and not more than 4 modules may be from the syllabuses for MSc (Eng) Internet computing if candidates opt for taking 12 modules. The list below is not final and some courses may not be offered every year.

SYLLABUSES

ECOM6001. Internet and the WWW (core)

This module covers the fundamentals of the essential components and technologies that are part of today's Internet, and the basic concepts that underlie the operation and the proliferation of the World Wide Web. Internet topics include TCP/IP, DNS, network infrastructures, and emerging technologies. World Wide Web topics include Web architecture, client/server operations, HTML and other ML's, Web services and Web security.

ECOM6004. Legal aspects of I.T. and e-commerce (core)

This module provides an introduction to some of the main legal problems generated by recent developments in information technology and e-commerce, and their possible solutions. Topics to be covered include copyright, patent protection for software and business methods, domain name disputes and other intellectual property issues on the Internet, contractual issues of on-line trading, public key infrastructure and electronic transactions, privacy and data protection. If time permits, the situation in the People's Republic of China will also be covered.

ECOM6008. Supply chain management (elective)

The objectives of this module are to provide participants with: (a) an understanding of the impact of supply chain management and related issues on the success and profitability of the modern organization; (b) the major challenges faced in implementing an integrated supply chain management strategy, as well as approaches for meeting these challenges; (c) the analytical and problem-solving skills necessary to develop solutions for a variety of logistics and supply chain problems; (d) the basic understanding about the application and the development of logistics and supply chain technology in Hong Kong industries.

ECOM6010. Strategic management of technology and innovation (elective)

This module is designed to provide students with a broad perspective about the key issues facing the effective management of technology in today's fast-changing, competitive, global environment. Drawing upon research over the last several decades, we will try to separate some of the facts from myths about what we do and do not know about the effective management of technology and innovation. We will also explore how fast changing information technologies such as the Internet might be transforming some of

⁵ This programme and syllabus are for students admitted to the first year of study for the degree of MSc(Eng) in Electronic Commerce in the 1999-2000 academic year.

the social/economic dynamics of product/service developments and innovations. The module aims to help students develop an understanding about the nature of technological work and the knowledge system in technology. From this basic understanding we will examine the role of technology in business strategy, and gain insight about the key factors affecting product development success or failure through various case discussions and review of empirical research findings.

ECOM6013. E-commerce technologies (core)

This module provides an overview of the technologies used in electronic commerce. These include (but not limited to) networking, object-oriented technology, computer and network security, databases, multimedia computing, search engine, data mining, intelligent agents.

ECOM6014. E-marketing (elective)

This module considers how to create customer centric strategies for e-businesses. Marketing focuses on the interaction between the producer and the consumer. Although this focus remains unchanged in e-marketing, our ability to foster this interaction with technology has been dramatically increased. The Internet provides new forms of communications like web sites, e-mail, and mobile communications. However, these technologies do not necessarily replace traditional marketing vehicles like mass media, direct mail, and telephone marketing, but instead augment them to improve the customer experience.

The primary focus of this module is how to more effectively implement marketing strategies using electronic technology. During this module we develop the notion of an interactive marketing strategy. This allows companies to interact with consumers on an individual basis and create customized products and services using personalized knowledge about a consumer. As part of this module we develop a compatible set of quantitative techniques to implement interactive marketing strategies. Throughout the module we explore examples and cases to understand how e-marketing is evolving in practice.

ECOM6015. Digital asset management (elective)

This module covers a range of technologies dealing with the decomposing, tagging, classifying, archiving, retrieving, filtering, structuring, and distributing of digital assets utilizing integrated digital asset management systems. The construction, use, reuse, retargeting, manipulation and transformation of alternative logical collections of digital assets and repositories are presented, as are tools to analyze assets in various types of repositories. In particular intellectual property, digital rights management and case studies are stressed.

ECOM6016. Electronic payment systems (elective)

This module deals with technology and computer systems for managing and handling payments across electronic networks. It covers topics on payment gateways, clearance, credit card transactions, digital cash, micro-payments, authenticity, integrity, intermediaries and risk management.

ECOM6022. Topics in electronic commerce (elective)

This module covers advanced topics in areas in electronic commerce that are relevant at the time. Leaders in the field, expert practitioners and distinguished scholars in the field around the world will be invited to participate in this module.

ECOM6020. Customer relationship management: business strategies and techniques (elective)

The objectives of this module are to understand CRM concepts and business strategies; CRM technologies and systems, typical business applications for CRM; and the process to implement CRM projects. CRM development in the People's Republic of China will be covered.

ECOM6027. Internet and e-commerce security (core)

This module provides an introduction on the technical issues concerning Internet and e-commerce security. It covers areas such as: protecting information using symmetric and public key cryptography; key management; trusted model and PKI; system and database security; mobile code security; wireless security; authentication and handshake protocols.

ECOM6028. Geo-spatial information for e-business applications (elective)

In this module, students learn the value of a spatial perspective in the business world. Students will be introduced to the characteristics of geo-spatial information, how to access it over the web and to the technology (GIS) which is used to store, manipulate and analyse this information. They will also learn how spatial analysis can use this information to produce new information critical to informed business decision making. A brief introduction to visualizing spatial information and implementing GIS in business is also included. Finally, the range of possibilities for distributing GIS-enabled services over the web is explored.

ECOM6009. Project (4 modules)**ECOM6029. E-business transformation (core)**

The first stage of e-commerce evolution -- the dotcom era -- is well over. As companies are cautiously entering the second stage of the "new economy" -- what can be called the e-business transformation era, they are facing a whole host of strategic, organizational, technical and increasingly global issues. Almost every company today is trying to find out how best to deploy the Internet throughout its value chain not only to improve operational efficiency but more importantly to create economic value. Such business transformation entails tight realignment of business strategy with IT strategy, setting up the necessary infrastructure, streamlining front-end and back-end business processes, managing new relationships and partnerships, and taking into consideration the emerging global issues.

This module provides a roadmap for managers planning to transform their companies into an internetworked enterprise where proprietary and shared infrastructures are used to link customers, suppliers, partners and employees to create superior economic value.

MSC(ENG) IN ENVIRONMENTAL ENGINEERING

The curriculum provides advanced education in the field of Water and Environmental Engineering. A candidate is permitted to proceed on a course of study under E16(a)(ii)(2) of the MSc(Eng) Regulations. Courses are one-module courses unless otherwise specified. The list of courses below is not final and some courses may not be offered every year. Students who intend to complete the curriculum in one academic year should check with the Department of Civil Engineering for the availability of the courses.

(A) **FIVE to EIGHT modules from the following list of courses or courses approved by the Department of Civil Engineering:**

CIVL6005. Advanced techniques of hydrological modelling and prediction

Time series analysis; hydrological forecasting; artificial neural networks in hydrology; chaos in hydrological time series.

CIVL6006. Advanced water and wastewater treatment

Water/wastewater characteristics and standards; coagulation/flocculation; sedimentation and filtration; membrane separation; adsorption; chemical oxidation; disinfection; biological removal of organic pollutants and nutrient.

CIVL6010. Coastal hydraulics and sedimentation

Tides and tidal currents; basic numerical techniques in mathematical models of tidal hydraulics and solute transport; tidal flushing and mariculture management; coastal sedimentation; impact of man-made changes on the coastal environment.

Prerequisite: Undergraduate course in hydraulics/fluid mechanics or equivalent

CIVL6023. Environmental chemistry

Water chemistry; microbial biochemistry; water pollution and treatment; soil chemistry; hazardous wastes; environmental chemical analyses.

CIVL6024. Environmental hydraulics

Effluent disposal; environmental transport phenomena in receiving waters; turbulent diffusion; jets and plumes; mixing in rivers and coastal waters; determination of assimilative capacity.

Prerequisite: Undergraduate course in fluid mechanics and environmental engineering or equivalent

CIVL6025. Environmental impact assessment of engineering projects

Environmental impact assessment process; methodologies to assess environmental impacts on water, air, and land; environmental management; case studies, e.g. on transportation projects, environmental control facilities and reclamation works.

CIVL6029. Groundwater hydrology

Review of groundwater flow through porous media; geotechnical applications; contaminant transport; hydrodynamic dispersion; diffusion; geochemical retardation and subsurface pathway analysis as applied to hazardous waste disposal.

CIVL6034. Municipal wastewater treatment

Municipal wastewater flows and characteristics; sewerage systems; preliminary, primary and secondary treatment processes; wastewater disinfection; advanced treatment for nutrient removal; sludge processing and disposal.

CIVL6040. Solid and hazardous waste management engineering

Resource use in modern society; sources, characteristics, and quantities of waste; environmental impact; waste prevention, reduction, and recycling; collection, transfer and transport; mechanical, biological, chemical and thermal processing; final disposal; case studies.

CIVL6050. Urban hydrology and hydraulics

Rainfall-runoff; hydrograph prediction; unsteady flow, flood routing; culvert hydraulics; flood control structures; stormwater management; storage concepts; river restoration; case studies.

CIVL6051. Water quality modelling

Mass balance and transport; biochemical processes and particle phenomena in natural environment; eutrophication; dissolved oxygen and algal dynamics; sediment-water-pollutant interactions; modelling application to rivers and estuaries.

Prerequisite: Undergraduate course in environmental engineering or equivalent

CIVL6053. Wind engineering

Statistical description of wind, parent and extreme wind data, wind profiles, wind effects on buildings and structures, wind pressures, quasi-steady approach, wind-induced vibration, dampers, codification of dynamic effects, wind effects on building ventilation, pedestrian-level wind environment, wind effects on pollutant dispersion, wind tunnel techniques.

CIVL6061. Special topic in environmental engineering A

This course provides an opportunity for students to study in-depth an area of environmental engineering of interest to students and staff alike. The topic will be announced in the beginning of the semester when the course is offered.

CIVL6062. Special topic in environmental engineering B

This course provides an opportunity for students to study in-depth an area of environmental engineering of interest to students and staff alike. The topic will be announced in the beginning of the semester when the course is offered.

(B) Not more than THREE modules from the MSc(Eng) courses offered by the Department of Civil Engineering other than those listed in (A) above, or courses offered by other Departments subject to the approval of the Head of the Department of Civil Engineering.

(C) CIVL6001. Project (4 modules)

On admission to the programme, students will undertake a supervised project which will be assessed. The project must relate to the subject matter and be agreed by the Department of Civil Engineering. In addition to satisfying MSc(Eng) Regulations E 18 and E 19, the progress of the project work will be assessed for the purpose of General Regulations G 11 and G 12 according to a timeframe set by the Department of Civil Engineering for submission of the following:

- (a) a tentative title, an outline and an inception report on the project,
- (b) a written report on the preliminary findings of the project, and
- (c) a draft dissertation and the final version of dissertation.

Failure to satisfy the examiners in the project milestones specified by the Department of Civil Engineering shall be considered as unsatisfactory performance or progress under the provisions of General Regulation G 11.

The final assessment of the project study shall be by an oral presentation AND a dissertation. Students are REQUIRED to give an oral presentation on the findings of their project studies in the form of a seminar at a time agreed by the Department of Civil Engineering prior to the submission of the dissertation. Failure in the oral presentation may lead to a failure in the project study as a whole.

MSC(ENG) IN GEOTECHNICAL ENGINEERING

The curriculum provides advanced education in the field of Geotechnical Engineering. A candidate is permitted to proceed on a course of study under E16(a)(ii)(2) of the MSc(Eng) Regulations. Courses are one-module courses unless otherwise specified. The list of courses below is not final and some courses may not be offered every year. Students who intend to complete the curriculum in one academic year should check with the Department of Civil Engineering for the availability of the courses.

(A) FIVE to EIGHT modules from the following list of courses or courses approved by the Department of Civil Engineering:**CIVL6004. Advanced soil mechanics**

Soil behaviour; stresses and strains in soil masses; stress path; soil deformation and consolidation theory; soil strength and failure criteria of soils; soil modelling techniques; earth pressure; laboratory testing applications.

CIVL6022. Engineering geology

Geology and ground profiles; engineering classifications and properties of rocks and soils; geological aspect of ground investigation; engineering geological mapping; rainfall and hydrogeology; structural geology; Karst formation; engineering geophysics; geohazard; engineering geology in construction; ground movement.

CIVL6027. Foundation engineering

Introduction to foundation engineering; shallow foundations; bearing capacity; stress distribution and settlements; deep foundations; pile installation and construction control; pile load tests; inspection of deep foundations; foundation on slopes.

CIVL6028. Ground improvement

A discussion of some principal ground improvement techniques for both granular and soft deposits, viz. surcharging with and without vertical drains, deep mixing methods, dynamic compaction and vibration, stone columns, grouting, geosynthetics and other novel schemes will be given. The principles and design considerations will be discussed through worked examples and case studies. Techniques of obtaining relevant soil parameters for design and the verification methods will also be covered.

CIVL6030. Landslip prevention

Soil and rock mechanics; slope stability evaluation; case histories of landslip in Hong Kong; landslip investigations; landslip prevention measures; slope maintenance; quantitative risk assessment; slope information system.

CIVL6035. Highway pavement engineering

Traffic loading; subgrade properties; soil stabilization; bituminous materials; flexible pavement design; rigid pavement design; pavement maintenance and upgrading; pavement management systems.

CIVL6036. Probabilistic methods in geotechnical engineering

Introduction to probability theory; Bayesian methods and subjectivity; methods for site investigation and design parameters; probabilistic design; risk; QRA method and application.

CIVL6038. Rock mechanics

Rock mass classification; rock mass strength and deformability as a function of structural defects such as joints; faults and bedding planes; in-situ rock stresses and their measurement; ground water percolation in rock; underground excavations and rock support system design; rock slope stability analysis; rock foundations; case histories in rock engineering; numerical methods; rock joint strength parameters; rockfall control.

CIVL6039. Slope stability and earth retaining structures

Slope engineering in Hong Kong; classification of slopes and earth retaining structures; rainfall and groundwater; construction of geological models for slopes and walls; slope stability analysis methods; design of cut and fill slopes; slope construction and monitoring; slope management and maintenance; design of retaining walls; reinforced earth; soil nailing; tied-back supports; rock slope stabilization measures; surface drainage and protection.

CIVL6043. Special topic in geotechnical engineering A

This course provides an opportunity for students to study in-depth an area of geotechnical engineering of interest to students and staff alike. The topic will be announced in the beginning of the semester when the course is offered.

CIVL6044. Special topic in geotechnical engineering B

This course provides an opportunity for students to study in-depth an area of geotechnical engineering of interest to students and staff alike. The topic will be announced in the beginning of the semester when the course is offered.

CIVL6055. Site formation for building works and infrastructure development

A discussion on various aspects of the planning, design and construction of site formation works which includes, inter alia, techniques for site characterisation, technical considerations, engineering issues regulatory requirements and lease conditions. Case histories will be used as illustrative examples for discussion and to highlight key issues.

CIVL6067. Underground excavation and tunnelling

Introduction to underground excavation and tunnels; shallow tunnels; deep tunnels; stress distribution and settlements around underground opening; site investigation requirements; analysis and design of underground opening; ground convergence support reaction curves, soil structure interaction; construction methods; computer programs; control of groundwater; construction monitoring.

(B) Not more than THREE modules from the MSc(Eng) courses offered by the Department of Civil Engineering other than those listed in (A) above, or courses offered by other Departments subject to the approval of the Head of the Department of Civil Engineering.

(C) CIVL6001. Project (4 modules)

For course descriptions, see the syllabuses of the MSc(Eng) in Environmental Engineering programme.

MSC(ENG) IN INDUSTRIAL ENGINEERING AND INDUSTRIAL MANAGEMENT

The curriculum extends over not less than two and not more than three calendar years of study. It provides advanced education and training in the philosophy, methods and techniques of Industrial Engineering and Industrial Management which are appropriate to industrial and service organizations in both the private and the public sectors.

Candidates are permitted to select courses in accordance with regulations E16 and E17.

IEIM6001. Concurrent engineering

Product development process analysis and reengineering: performance measurement, organisation and management issues and extended enterprises. Formal methods and techniques, "Design for X", arc conjoint analysis. Product management, product variety, and engineering changes. Collaborative product commerce: information/task sharing, customer/supplier involvement and e-commerce/e-business applications. Case studies in logistics, service and manufacturing industries.

IEIM6002. Operations management

Elements of operations strategies; quantitative forecasting models; strategic decisions; planning products, processes, technologies, and facilities; selection and management of production technology; capacity planning and facility location; production planning systems; aggregate planning; master production scheduling; inventory systems; material requirement planning; shop floor planning and control; Just-In-Time manufacturing.

IEIM6004. Industrial project management

Elements of project management; approach to project management; project evaluation; project selection and proposal preparation; project planning and scheduling; project organisation; project team and project manager; project monitoring and control; resource management; resource planning; resource allocation in project networks; multi-criteria decision making process; the analytic hierarchy process; PERT/GANTT techniques for project control and resource allocation; case studies.

IEIM6027. Organisation theory and behavioural science

Managing and managers; evolution of management theory. Planning- decision making; strategic management; strategy implementation. Organising- organisational design and structure; power and the distribution of authority; managing organisational change and innovation. Leading- motivation; leadership; teams and teamwork; communication and negotiation. Controlling- principles of effective control; operations control.

IEIM6028. Enterprise logistics and facilities design

Enterprise logistics: materials handling systems, storage and warehousing operations, competitive manufacturing, modelling and analysis of enterprise logistics systems; location analysis; methodologies for facilities planning: systematic layout planning, FacPlan, manufacturing strategies; layout planning algorithms.

IEIM6030. Ergonomics

Ergonomics and systems design. Physical ergonomics, anthropometry, biomechanics. Human information processing, person-machine interface design, displays and controls. The visual environment and visual performance. Thermal environment and effects on performance, indices of comfort. Noise; noise measurement, effects of noise, control of noise. Vibration and acceleration; human tolerance.

IEIM6034. Operational research techniques

The philosophy and methodology of Operational Research: problem analysis, model building, and implementation of solutions. Mathematical programming and its applications in logistics and supplies: vehicle scheduling, transportation and transshipments problems. Replacement models for capital equipment and preventive replacement for components of low capital value. Risk analysis for capital expenditure proposals. Queuing theory and event simulation with applications in serial and parallel supply chains.

IEIM6037. Costing and finance

Cost terms and purposes, allocation and absorption of overheads, product costing, budgetary control and standard costing, variance analysis, cost for decision making, capital investment appraisal, risk analysis. Interpretation of published accounts, ratio analysis, sources of short term funds, management of working capital, choice of long term finance, the concept of cost of capital.

IEIM6042. Quality management

The principals of Total Quality Management and BS 7850. Basic tools of quality management, the Japanese approaches to quality management, 5S and Kaizen. Deming's approach to quality management. International quality assurance management system -- the ISO 9000 series, quality documentation, quality audit. Zero defects and Six Sigma. The American Malcolm Baldrige quality award. Quality Function Deployment. The Taguchi Methods.

IEIM6043. Information technology management

Managerial and organizational impact of information technology (IT). Contemporary IT topics; Internet, intranet, extranet, groupware, data mining, multimedia systems. Artificial intelligence and its applications in enterprise systems. Applications of IT in improving the competitiveness of organizations; business process re-engineering, knowledge management, IT outsourcing and frameworks for strategic information systems planning.

IEIM6044. Supply chain management

Supply chain characterisation; operation objectives; distribution channels; channel design considerations; logistics network design. Inventory management; risk pooling; distribution strategies. Strategic alliances; international issues in supply chain management; coordinating product and supply chain design; customer value. Information technology; decision support systems; the value of information in supply chains. Case studies and contemporary topics on supply chain management; the beer game.

IEIM6045. Global operations and logistics

Global operations and logistics strategies, strategic changes required by globalization, the strategic framework for global operations, the role of logistics in global operations and marketing strategies; global operations and logistics planning, supplier network development, physical distribution, global logistics network design, global supply chain management, risk management in global operations; management of global operations and logistics, operations analysis of global supply chains, information management for global logistics, performance measurement and evaluation in global logistics.

IEIM6046. Supply management

Purchasing in the supply chain, strategic purchasing, implementation and evaluation of strategy; purchasing organisation in a corporation, impact of e-procurement; out-sourcing, supplier selection, partnership with suppliers; pricing agreement, price analysis; global sourcing.

IEIM6047. Digital enterprises

Overview and development of e-business; e-business technologies and solutions: appraisal and selection, implementation and adoption; Enterprise information and knowledge portals, virtual enterprises; Roles of e-business in enterprise development and integration; Application case studies in enterprise business processes: (product development, order taking and processing, online contract negotiation and bidding, rapid quotation and cost estimation, etc.).

IEIM6048. Terminal and warehousing operations

Materials handling systems, automated storage and distribution systems, hardware and software, routing. Case studies from cargo terminals. Warehouse management systems, missions, functions, receiving and shipping operations planning, dock design, storage space, layout and location planning, order picking. Material handling principles, system design, selection of handling equipment, unit load design. Automation of warehouse and material handling systems, costing and audits. Applications of modelling, simulation, virtual reality software for warehouse design and optimisation.

IEIM6049. Advanced manufacturing systems

Agile manufacturing strategies, process choice; types of advanced manufacturing systems: FMS, reconfigurable manufacturing systems, holonic manufacturing system; elements of advanced manufacturing systems: production, handling, storage, sensing and control; manufacturing cell; modelling and design of advanced manufacturing systems; networked manufacturing; scheduling and dispatching.

IEIM6025. Project (4 modules)**CIMA6001. Geometric modelling and computer graphics**

2D, 3D geometric modelling principles: information representation and manipulation, mathematical bases, graphics rendering techniques; elements of computer graphics; graphics packages and standards; data exchange standards.

CIMA6004. Computer-aided manufacturing

Numerical control principles and applications; computer aided process planning; industrial robots; flexible manufacturing systems; computer aided production management; computer aided process control and quality control; applications of AI in manufacturing; CAD/CAM evaluation and implementation; computer integrated manufacturing (CIM).

MSC(ENG) IN INFRASTRUCTURE PROJECT MANAGEMENT

The curriculum provides advanced education in the Management of Infrastructure Projects over their entire life cycle, i.e. from conceptualisation and feasibility studies, through financing, contract administration, design, construction, commissioning, operation & maintenance, evaluation and decommissioning. This will draw on and synergise relevant Departmental strengths in Construction Engineering and Management, Transport and Development, Environmental Engineering, Structural Engineering and Geotechnical Engineering, as well as relevant industry expertise.

A candidate is permitted to proceed on a course of study under E16(a)(ii)(2) of the MSc(Eng) Regulations. Courses are one-module courses unless otherwise specified. The list of courses below is not final and some courses may not be offered every year. Students who intend to complete the curriculum in one academic year should check with the Department of Civil Engineering for the availability of the courses.

(A) FIVE to EIGHT modules from the following list of courses or courses approved by the Department of Civil Engineering:

CIVL6009. Building planning and control

Buildings Ordinance and its implementation, regulations, codes of practice and practice notes; building planning process; site safety supervision and safety assurance; quality assurance of materials and construction; demolition; temporary works; drainage works; case studies.

CIVL6013. Concrete technology

Concrete mixes; quality control; in-situ strength assessment; non-destructive testing; cracks and other defects; maintenance and repair.

CIVL6014. Construction dispute resolution

Introduction to disputes, claims and methods of dispute avoidance and resolution in construction; mediation; arbitration: fundamental principles, arbitration agreement, arbitration rules, appointment of arbitrators, power and duties of arbitrators, pre-hearing proceedings, hearing, award, role of the court; other ADR (alternative dispute resolution) methods; litigation.

CIVL6015. Construction financial management

Estimating and costing; tendering strategy; productivity analysis; financial accounting; financial management; management accounting; taxation effects.

CIVL6018. Infrastructure project management techniques

Operations research and quantitative techniques in construction management; risk analysis; project feasibility analysis; lean construction; value management; supply chain management; IT aids in planning and control of construction projects; construction process re-engineering.

CIVL6019. Construction technology

Mechanisation, automation and robotics in construction processes; construction plant and equipment; temporary works; common construction materials; materials testing and quality control; quality systems; method statements.

CIVL6021. Infrastructure contracts management

Infrastructure project packaging; different types and forms of construction contracts; selection of consultants and contractors; management of the tender phase; management of design; administration of construction contracts; construction claims management.

CIVL6025. Environmental impact assessment of engineering projects

For course descriptions, see the syllabuses of the MSc(Eng) in Environmental Engineering programme.

CIVL6030. Landslip prevention

For course descriptions, see the syllabuses of the MSc(Eng) in Geotechnical Engineering programme.

CIVL6035. Highway pavement engineering

For course descriptions, see the syllabuses of the MSc(Eng) in Geotechnical Engineering programme.

CIVL6037. Project management - human and organisational factors

Management theories; organisations structures and cultures; project management and project teams; leadership; ethics; communication; negotiations; recruitment.

CIVL6048. Planning of transport infrastructure systems

Introduction to systems engineering, urban system models, network modelling concepts and techniques, trip assignment models.

CIVL6049. Urban development management by engineering approach

Urban development process, introductory town planning; transport modelling; integration of infrastructure and service planning; optimisation and risk management; integration of planning and implementation of engineering works; urban development; project management; principles of building control; integration of theory and practice; case studies.

CIVL6055. Site formation for building works and infrastructure development

For course descriptions, see the syllabuses of the MSc(Eng) in Geotechnical Engineering programme.

CIVL6058. Management of infrastructure megaprojects

Public Works financing; Public-Private-Partnerships (PPPs) including BOT-type developments; selecting appropriate procurement frameworks; multi-party contractual links; co-ordinating large work packages; interface management; JVs and cross-cultural issues; critical success factors and best practices.

CIVL6059. Special topic in infrastructure project management

This course provides an opportunity for students to study in-depth an area of infrastructure project management of interest to students and staff alike. The topic will be announced in the beginning of the semester when the course is offered.

CIVL6060. Operation and maintenance of building and civil engineering works

Policies, principles and practices in operation, maintenance and rehabilitation of buildings and civil engineering infrastructure such as: bridges, roadworks, marine and port works, water supply systems and sewerage schemes; and including aspects of: inspection, appraisal, materials repair methods, monitoring systems and forensic engineering.

(B) Not more than THREE modules from the MSc(Eng) courses offered by the Department of Civil Engineering other than those listed in (A) above, or courses offered by other Departments subject to the approval of the Head of the Department of Civil Engineering.

(C) CIVL6001. Project (4 modules)

For course descriptions, see the syllabuses of the MSc(Eng) in Environmental Engineering programme.

MSC(ENG) IN MECHANICAL ENGINEERING**General or Theme-related?**

Students with a general interest in the broad field of Mechanical Engineering may choose from the wide range of advanced courses available, without following any particular theme. However, some students may wish to concentrate on a coherent set of courses that follow a theme. At the present time, the Department offers the theme "Energy and Environment", and students wishing to follow this theme are encouraged to select courses from a recommended list.

The "Energy and Environment" Theme*Energy and Environment*

Worldwide there are increasing problems of pollution associated with energy usage. Therefore, this theme embraces indoor and outdoor environmental pollution, together with the efficient production and use of energy. The core modules are structured to provide students with the engineering knowledge and tools to tackle problems often found in the natural and built environment. The primary emphasis is on mechanical topics, but students interested in other environmental areas may choose to take suitable courses available elsewhere in the Faculty.

Full details of all the courses offered by the Department are given in the Curriculum section. However, students opting for this theme will select most of their courses from the following subset:

Courses for “Energy and Environment”

MECH6007 Project (4 modules)
 MECH6009 Renewable energy technology I
 MECH6017 Noise and vibration
 MECH6018 Atmospheric environment modelling
 MECH6019 Sources and control of air pollution
 MECH6023 Power plant technology
 MECH6024 Applied mathematics for engineers
 MECH6026 Computational fluid dynamics
 MECH6033 Energy conservation and management
 MECH6038 Renewable energy technology II
 MEBS6004 Built environment
 MEBS6010 Indoor air quality

Curriculum

The curriculum is designed for a minimum of two calendar years and a maximum of three calendar years of study.

A taught Master student will not be permitted to select a course whose contents are similar or identical to any course he/she has previously taken for the purpose of fulfilling the requirements of another degree.

Every lecture-based course constitutes 1 module, whereas the project constitutes 4 modules. Each student is required to follow a course of study comprising 12 modules, with the option of doing either 12 lecture-based courses or 8 lecture-based courses plus a project. Students who opt to do 12 lecture-based courses must select at least 8 from the list below, while those doing a project should select at least 5. Furthermore, students following the “Energy and Environment” theme are encouraged to select their core set of lecture-based courses from the subset given in the previous section. After satisfying this basic requirement, the remaining courses may either be selected from the list below or from courses offered by other departments.

The following list is not final and some courses may not be offered every year.

MECH6007. Project (4 modules)

Students will undertake an assigned and supervised project which will be assessed. The project must relate to the subject matter of the curriculum and be agreed by the Department of Mechanical Engineering.

MECH6001. Advanced design methods and applications

Engineering design; axiomatic design; creative design; design for human factors; optimization design; design for product lifecycle; design for manufacturability; design for assembly; robust design; reliability design.

MECH6003. Advanced fluid mechanics

Fundamental concepts and equations; hydrodynamic lubrication; boundary layers; turbulent flow; pipe flows; open channel flows.

MECH6009. Renewable energy technology I

Basic energy concepts; present-day fuel use; sustainability problems; solar thermal energy and direct conversion systems; wind turbines; biomass; bio-fuels; energy from refuse; tidal power; wave energy technology; hydrogen energy and fuel cells.

MECH6010. Service behaviour of materials

Creep regimes; creep mechanisms; creep resistant alloys; brittle fracture; ductile fracture; brittle-ductile transition; fracture mechanism maps; fatigue; Basquins and Coffin-Manson Laws; Goodman's relation; Palmgren-Miner rule; corrosion; electrochemical principles; forms of corrosion; corrosion control; case studies; introduction to polymer-matrix composites.

MECH6017. Noise and vibration

Fundamentals of noise; response of human ear and hearing loss; noise measurement; noise in rooms; acoustic absorption and transmission through walls; noise control measures; Hong Kong noise control legislation and planning guidelines; fundamentals of vibration; vibration and shock isolation; absorbers and damping; vibration measurement; dynamic balancing of rotors *in situ*.

MECH6018. Atmospheric environment modelling

Foundations of atmospheric dynamics; models of winds; atmospheric turbulence modelling; boundary layer climates; air pollution in boundary layer; atmospheric diffusion theories.

MECH6019. Sources and control of air pollution

Basics of air pollution; air pollution transports; sources of air pollutants; control of gaseous pollutants; control of particulate matter; atmospheric dispersion modelling.

MECH6021. Marine hydrodynamics

Development of hydrodynamic principles and their applications to marine vessels and structures. Dimensional analysis, similitude and model testing; viscous and ideal flows; lifting surfaces; wave, wave loading on small and large bodies; response of floating bodies to wave; hydrodynamics of slender bodies.

MECH6022. Offshore engineering design

Offshore structural configurations; environmental conditions, design criteria and code requirements; deterministic and stochastic design approaches; design of offshore structures; numerical methods for marine applications.

MECH6023. Power plant technology

Historical development; energy resources; steam and vapour cycles; boilers; fuels and combustion; steam turbines; gas turbines; principles of nuclear energy; radioactivity; reaction rate and power shape; nuclear reactor thermal-hydraulics; Pressurized Water Reactor power plant and its design limits.

MECH6024. Applied mathematics for engineers

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.

MECH6025. Marine propulsion plant

Machinery systems; design criteria; prime mover efficiency; energy saving methods. Propulsion; fixed and controllable pitch propellers; design procedures; matching of hull, propeller, diesel engine and turbocharger. Marine shafting design; alignment; vibration; thrust and tail shaft bearings.

MECH6026. Computational fluid dynamics

Fundamental concepts and equations of thermal fluid dynamics; finite-difference method for solving partial differential equations (stability, consistency, convergence, accuracy and efficiency, and solution of system of algebraic equations); simplified models for fluid flow (wave equation) and heat transfer (heat equation); grid generation; turbulent diffusion and shear flow dispersion; numerical solution of transport equations (mass; momentum and energy transport); applications involving the built environment, air pollution, atmospheric diffusion and dissipation, power-plant design, land- air- and marine-vehicle design; etc.

MECH6028. Processing and properties of engineering plastics

Extrusion; injection moulding; blow moulding; solid phase forming; joining; plating; yield criteria; environmental stress cracking; UV degradation; flame retardation; viscoelastic behaviour of plastics; dynamic behaviour; design methods for plastics based on creep data.

MECH6030. Computer control for manufacturing processes

Structure of process control computers; interface; z-transform, sampling theory; discrete-time models; stability analysis; discrete controller design; optimal control; state space representation and controller design; parameter estimation; self-tuning controllers; control applications.

MECH6031. Computer automated inspection

Inspection planning; process capability; control charts; optical gauging and profiling; image acquisition and storage; lighting and optical systems; image processing and understanding; pattern recognition and decision making; coordinate measuring machines (CMM); CAD-based CMM inspection.

MECH6032. MEMS & Microsystems design and manufacturing

MEMS and microsystem products; microsensors; microactuation; multidisciplinary nature of microsystem design and manufacture; materials for MEMS and Microsystems; micromanufacturing; microsystem design; microsystem packaging.

MECH6033. Energy conservation and management

Energy sources and environmental impact; energy in buildings; energy-efficient industrial processes; waste heat recovery; energy storage; energy auditing; economic analysis; energy strategies and management.

MECH6034. Computer-aided product development (CAPD)

CAD modeling; Haptic shape modeling; reverse engineering; prototyping; product development case studies.

MECH6035. Finite element applications in product design

Concepts in finite element analysis; finite elements in vibration analysis; finite elements in design optimisation; introduction to nonlinear and multi-physics analyses; practical sessions on solving engineering problems by using a state-of-art finite element software.

MECH6036. Engineering stress and strength analysis

Introduction to fracture mechanics and fatigue analysis; design against fracture and fatigue failure; introduction to impact mechanics; design for impact loads; impact testing: charpy; izod; strain gauge method; photoelasticity; moire and interferometric methods; practical sessions.

MECH6037. Mechatronics and motion control for product design

Introduction to mechatronic systems; actuators; drives; sensors and measurement; motion control design; mechatronic product design.

MECH6038. Renewable energy technology II

Prospects of renewable energy sources; sun-earth trigonometry; beam and diffuse radiation; collector types; solar heating and cooling; system design; tracking; photovoltaics; Wind energy resources; aerodynamics; blades element theory; components and operational characteristics; utility connected wind turbines; off shore wind farms.

Pre-requisite: MECH6009

MECH6039. Biomaterials and tissue engineering

Bioactive bioceramics; bioactive composites; surface modification of metallic biomaterials; blood-contacting biomaterials; advanced testing and analytical techniques for biomaterials; long-term

performance of biomaterials; clinical applications of biomaterials; tissue engineering: principles, methods and applications; standards and regulatory issues.

MECH6040. Foundations of nanotechnology

Characteristic length scales, nanomaterials, nanostructures, physical properties of nanostructures, deposition techniques of nanofabrication, high resolution analysis and characterization, scanning probes 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.

CIMA6001. Geometric modelling and computer graphics

2D, 3D geometric modelling principles: information representation and manipulation, mathematical bases, graphics rendering techniques; elements of computer graphics; graphics packages and standards; data exchange standards.

CIMA6004. Computer-aided manufacturing

Numerical control principles and applications; computer aided process planning; industrial robots; flexible manufacturing systems; computer aided production management; computer aided process control and quality control; applications of AI in manufacturing; CAD/CAM evaluation and implementation; computer integrated manufacturing (CIM).

MEBS6004. Built environment

External environment: human factors, climatology; internal design criteria; thermal environment (heat): insulation for energy conservation, heat transmission; e.g. solar contribution; visual environment (light): eye and vision, light production, levels of illumination; aural environment (sound or noise): noise criteria for buildings; sources of noise and vibration, noise and vibration control; functional requirement of buildings.

MEBS6010. Indoor air quality

Concept of indoor air quality, health requirements, sick building syndrome, building related illnesses, indoor air quality indicators, types, sources, characterization and health effects of pollutants, concentration, individual and population exposure, dose-response relationships, measurement and monitoring methods, ventilation, filtration, indoor air quality assessment and control, operation and maintenance, legislation and public policy issues, energy and cost implications.

MSC(ENG) IN STRUCTURAL ENGINEERING

The curriculum provides advanced education in the field of Structural Engineering. A candidate is permitted to proceed on a course of study under E16(a)(ii)(2) of the MSc(Eng) Regulations.

The list of courses below is not final, and may be changed from time to time. Courses are one-module courses unless otherwise specified. Students who intend to complete the curriculum in one academic year should check with the Department of Civil Engineering for the availability of the courses.

(A) **FIVE to EIGHT modules from the following list of courses or courses approved by the Department of Civil Engineering:**

CIVL6002. Advanced finite elements

Isoparametric elements; boundary integrals; dynamics and stability; non-linear analysis; finite strip method.

Prerequisite: CIVL6026 Finite element method

CIVL6003. Advanced reinforced concrete structure design

Flexural, shear and torsional behaviours of reinforced concrete members; yield line theory; strut and tie theory; effects of confinement reinforcement; design of reinforced concrete frames and shear walls; design of high-strength concrete members.

CIVL6008. Bridge engineering

Choice of structural systems; construction materials; construction methods; loading on bridges; analysis of bridge decks; bridge substructures; introduction to bridge bearings and joints.

CIVL6013. Concrete technology

For course descriptions, see the syllabuses of the MSc(Eng) in Infrastructure Project Management programme.

CIVL6020. Design of earthquake resistant structures

Introduction about earthquake, general philosophy, concept of ductility; structural system and configuration, lateral load resisting system and earthquake force distribution; structural design consideration, code consideration, aspects of detailing; overview of strengthening and retrofitting, overview of external devices as earthquake resisting system.

CIVL6026. Finite element method

Elasticity; calculus of variation; energy methods; shape functions; two and three-dimensional problems; plate bending elements; field problems.

CIVL6032. Long-span structures

Design strategies for long-span structures; arches; domes; cable-supported structures; suspension and cable-stayed bridges; space frames; membrane structures; hyperbolic paraboloids.

CIVL6045. Tall building structures

Coupled shear/core walls; coupling effects of beams and slabs; finite element analysis of building structures; wall-frame interaction; framed-tube structures; tube-in-tube structures; outrigger braced structures; shear lag effects in core walls.

CIVL6053. Wind engineering

For course descriptions, see the syllabuses of the MSc(Eng) in Environmental Engineering programme.

CIVL6063. Special topic in structural engineering A

This course provides an opportunity for students to study in-depth an area of structural engineering of interest to students and staff alike. The topic will be announced in the beginning of the semester when the course is offered.

CIVL6064. Special topic in structural engineering B

This course provides an opportunity for students to study in-depth an area of structural engineering of interest to students and staff alike. The topic will be announced in the beginning of the semester when the course is offered.

CIVL6065. Earthquake engineering

Earthquake hazard, ground shaking and types of damage; seismic hazard assessment; site (soil) effects; structural response to earthquakes; elastic and inelastic response spectra; seismic design spectra; seismic capacity and risk assessment for new and existing structures.

CIVL6066. Structural dynamics

Theory of dynamics with applications to civil engineering structures; free and forced vibration; single and multi-degree of freedom dynamic systems; the nature and effects of earthquake and wind-induced vibrations; analysis of earthquake and wind dynamic response; deterministic and non-deterministic approaches.

CIVL6068. Bridge aerodynamics and seismic stability

Wind phenomenology; wind loading description; random vibrations; aeroelastic phenomena; buffeting responses; self-excited responses; wind tunnel tests; engineering seismology; seismic hazard analysis; spectrum response analysis; time history response analysis and push over analysis.

CIVL6069. Bridge instrumentation and health monitoring

Bridge health monitoring; monitoring methods, monitoring parameters; bridge rating system; architectural layout of instrumentation system; sensory systems; data acquisition systems; data transmission and communication systems; methods and tools for processing, analysis and interpretation of data; performance specification preparation, analysis and interpretation of measured data and structural health evaluation.

- (B) Not more than THREE modules from the MSc(Eng) courses offered by the Department of Civil Engineering other than those listed in (A) above, or courses offered by other Departments subject to the approval of the Head of the Department of Civil Engineering.**
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- (C) CIVL6001. Project (4 modules)**

For course descriptions, see the syllabuses of the MSc(Eng) in Environmental Engineering programme.

MSC(ENG) IN TRANSPORTATION ENGINEERING

The curriculum provides advanced education in the field of Transportation Engineering. A candidate is permitted to proceed on a course of study under E16(a)(ii)(2) of the MSc(Eng) Regulations. Courses are one-module courses unless otherwise specified. The list below is not final and some courses may not be offered every year. Students who intend to complete the curriculum in one academic year should check with the Department of Civil Engineering for the availability of the courses.

- (A) FIVE to EIGHT modules from the following list of courses or courses approved by the Department of Civil Engineering:**

- CIVL6007. Behavioural travel demand models**

This course will cover the basic as well as modern and advanced techniques in travel demand modelling. Topics will include demand theory, mathematical models, survey methods in transport, land use transportation models, disaggregate choice models, and behavioural concepts in choice modelling.

- CIVL6025. Environmental impact assessment of engineering projects**

For course descriptions, see the syllabuses of the MSc(Eng) in Environmental Engineering programme.

- CIVL6035. Highway pavement engineering**

For course descriptions, see the syllabuses of the MSc(Eng) in Geotechnical Engineering programme.

- CIVL6037. Project management - human and organizational factors**

For course descriptions, see the syllabuses of the MSc(Eng) in Infrastructure Project Management programme.

- CIVL6046. Theory of traffic flow**

Measurements and statistical distributions of traffic characteristics; traffic stream models; car-following theories; hydrodynamic theory of traffic flow; traffic queues and delays.

CIVL6047. Traffic management and control

Transportation networks; network equilibrium concepts; estimation of origin-destination matrix; traffic management measures; traffic control techniques.

CIVL6048. Planning of transport infrastructure systems

For course descriptions, see the syllabuses of the MSc(Eng) in Infrastructure Project Management programme.

CIVL6049. Urban development management by engineering approach

For course descriptions, see the syllabuses of the MSc(Eng) in Infrastructure Project Management programme.

CIVL6054. Engineering for transport systems

The course will introduce students to the basic performance characteristics of various transportation modes for passengers and freight. The focus will be on the interaction between performance and factors related to transportation technology, facility, system design and patterns of demand.

CIVL6056. Special topic in transportation engineering A

This course provides an opportunity for students to study in-depth an area of transportation engineering of interest to students and staff alike. The topic will be announced in the beginning of the semester when the course is offered.

CIVL6057. Special topic in transportation engineering B

This course provides an opportunity for students to study in-depth an area of transportation engineering of interest to students and staff alike. The topic will be announced in the beginning of the semester when the course is offered.

CIVL6070. Logistics and transportation

The logistics supply chain, evolution of logistics and the supply chain as management disciplines; the customer service dimensions; transportation fundamentals, transportation decisions; inventory concepts, inventory management; facility location decisions, the network planning process; logistics organization, best practice and benchmarking; discussion on contemporary issues in logistics.

(B) Not more than THREE modules from the MSc(Eng) courses offered by the Department of Civil Engineering other than those listed in (A) above, or courses offered by other Departments subject to the approval of the Head of the Department of Civil Engineering.

(C) CIVL6001. Project (4 modules)

For course descriptions, see the syllabuses of the MSc(Eng) in Environmental Engineering programme.