Subject to approval

MSc in EEE-A (2020-2021) V1:2020200309

SYLLABUS FOR THE DEGREE OF MASTER OF SCIENCE IN ENGINEERING IN ELECTRICAL AND ELECTRONIC ENGINEERING
MSC(ENG)(EEE)

(This syllabus is applicable to students admitted to the curriculum in the academic year 2019-2020 and thereafter)

Definition and Terminology

Discipline course – any course on a list of courses in the discipline of curriculum which a candidate must pass at least a certain number of credits as specified in the Regulations.

Elective course – any course offered by the Departments of the Faculty of Engineering for the fulfilment of the curriculum requirements of the degree of MSc(Eng) in Electrical and Electronic Engineering that are not classified as discipline courses.

Capstone Experience – a 12-credit project or a 24-credit dissertation which is a compulsory and integral part of the curriculum.

Curriculum Structure

Candidates are required to complete 72 credits of courses as set out below, normally over one academic year of full-time study or two academic years of part-time study:

	Enrolment Mode of 10 courses + Project	**Enrolment Mode of 8 courses + Dissertation**
Course Category	**No. of Credits**	**No. of Credits**
Discipline Courses	General stream: not less than 36 credits in Group A, B or C Communication Engineering stream: not less than 36 credits in Group B Communications Engineering Power Engineering stream: not less than 36 credits in Group C Power Engineering	General stream: not less than 30 credits in Group A, B or C Communication Engineering stream: not less than 30 credits in Group B Communications Engineering Power Engineering stream: not less than 30 credits in Group C Power Engineering
Elective Courses	Not more than 24	Not more than 18
Capstone Experience	12	24
Total	72	72

Candidates shall select courses in accordance with the regulations of the degree. Candidates must complete 8 courses plus a dissertation or 10 courses plus a project.. All course selection will be subject to approval by the Course Coordinators.

Candidates are required to follow the prescribed curriculum of one of the three streams: General

Stream, Communications Engineering and Power Engineering. The Department also offers an optional course in the Professional Development subject group, namely ELEC7900 Engineering and society, which will not be counted for the fulfilment of the curriculum requirements and the classification of award of the degree.

The following is a list of discipline courses offered by the Department of Electrical and Electronic Engineering. The list below is not final and some courses may not be offered every year.

All courses are assessed through examination and / or coursework assessment, the weightings of which are subject to approval by the Board of Examiners.

Subject Groups

A. General

ELEC6008	Pattern recognition and machine learning
ELEC6027	Integrated circuit systems design
ELEC6036	High performance computer architecture
ELEC6043	Digital image processing
ELEC6049	Digital system design techniques
ELEC6063	Optoelectronics and lightwave technology
ELEC6067	Magnetic resonance imaging (MRI) technology and applications
ELEC6079	Biomedical ultrasound
ELEC6081	Biomedical signals and systems
ELEC6092	Green project management
ELEC6105	Magnetics engineering for data storage and emerging applications
ELEC6106	From AI software to hardware: an introduction of machine learning and EDA
ELEC6601	Industrial marketing
ELEC6602	Business venture in China
ELEC6603	Success in industrial entrepreneurship
ELEC6604	Neural networks, fuzzy systems and genetic algorithms
ELEC7078	Advanced topics in electrical and electronic engineering
ELEC7079	Investment and trading for engineering students
ELEC7080	Algorithmic trading and high frequency trading
ELEC7081	Advanced topics in computational finance
ELEC7082	Artificial intelligence in finance

B. Communications Engineering

ELEC6006	Communications policy and regulations
ELEC6026	Digital signal processing
ELEC6065	Data compression

ELEC6080	Telecommunications systems and management
ELEC6097	IP networks
ELEC6098	Electronic and mobile commerce
ELEC6099	Wireless communications and networking
ELEC6100	Digital communications
ELEC6103	Satellite communications
ELEC7051	Advanced topics in communication theory and systems
ELEC7077	Advanced topics in multimedia signals and systems

C. Power Engineering

ELEC6055	Power system distribution
ELEC6084	Power delivery management for metropolitan cities
ELEC6085	The role of a computerized SCADA system in power system operation
ELEC6095	Smart grid
ELEC7402	Advanced electric vehicle technology
ELEC7403	Advanced power electronics
ELEC7404	Advanced railway engineering
ELEC7456	Advanced power system operation
ELEC7466	Advanced topics in power system engineering
MEBS6001	Electrical installations
MEBS6019	Extra-low-voltage electrical systems in buildings

D. Professional Development

ELEC7900	Engineering and society (This course will not be counted for the fulfilment of the curriculum requirements and the classification of award of the degree.)

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

All courses are assessed through examination and/or coursework assessment.

ELEC6006. Communications policy and regulations (6 credits)

This course aims to provide a comprehensive understanding of Communications Policy and Regulations, and latest ICT policy and regulatory practices in the leading markets and economies. It helps students to appreciate the integration of multi-disciplinary knowledge in ICT industry.

The course also covers some advanced policy & regulatory topics in the ICT industry including convergence licensing regime, co-regulation/self-regulation, and consumer protection regulation.

ELEC6008. Pattern recognition and machine learning (6 credits)

This course aims at providing fundamental knowledge on the principles and techniques of pattern recognition and machine learning.

Specifically, the course covers the following topics: Bayes decision theory; parametric and non-parametric methods; linear discriminant functions; unsupervised learning and clustering; feature extraction; neural networks; context-dependent classification; case studies.

Pre-requisite: A good background in linear algebra, programming experience.

Mutually exclusive with: COMP7504 Pattern recognition and applications

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ELEC6026. Digital signal processing (6 credits)

This course provides an introduction to the fundamental concepts of digital signal processing (DSP) including a wide variety of topics such as discrete-time linear-time invariant systems, sampling theorem, z-transform, discrete-time/discrete Fourier transform, and digital filter design. Furthermore, the course will also discuss in detail about other advanced topics in digital signal processing such as multidimensional signals and systems, random processes and applications, and adaptive signal processing.

ELEC6027. Integrated circuit systems design (6 credits)

This course covers the following topics: 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.

ELEC6036. High-performance computer architecture (6 credits)

This course aims at providing an in-depth understanding of the principles, architectures and implementations of modern high performance computer systems which are designed and based on the proactive use of instruction-level parallelism (ILP). Specifically, the course discusses with examples and case studies to investigate the high-performance computing models; pipelining and ILP; advanced pipelining design including the scoreboard and Tomasulo algorithm; speculative execution; advanced computing models such as the cloud computing models and their possible uses in general, scientific or financial applications; and case studies like the Amazon EC2 and Google Cloud platforms.

ELEC6043. Digital image processing (6 credits)

This course deals with the theory, techniques and applications of digital image processing, which includes characterization, enhancement, restoration, feature extraction, representation, description and classification, advance topics in image analysis, image motion, and application case studies.

Specifically, it covers the areas of image acquisition and imaging systems, 2D continuous-time and discrete-time signals and systems, time and frequency representations, sampling and quantization issues, image filtering, convolution and enhancement, image reconstruction and restoration, image quality evaluation, image transform and compression, geometric feature extraction, image representation and description, image analysis, motion and case studies.

Prerequisite: Exposure to signals and systems at the level of ELEC3241

ELEC6049. Digital system design techniques (6 credits)

This course aims to provide a structured approach to digital system design. Fundamental to this is an understanding of the underlying technologies for modern day digital systems and the methods of analysis. Systematic design methodology and computer aids are crucial to tackling systems of increasing complexity. Selected design issues (such as faults, testability) will also be presented where appropriate.

The course begins with an overview of digital technologies, their evolution and the implication on design realization. Students are updated on fundamental theories and essential building blocks to prepare them for higher level systems design. A structured approach is used to quickly guide students from basic combinational logic to more complex digital systems such as RTL or programmable processors. Design tradeoffs and optimizations are emphasized as an integral part of the design process.

The course also covers hardware description language (Verilog) as a high level design tool. Where resources allow, students will have the chance of gaining experience on the use of Verilog.

ELEC6055. Power system distribution (6 credits)

This course provides a platform for electrical engineers to strengthen their technical expertise in power distribution from design to application at an advanced level. State-of-the-art technologies for distributing electricity safely, reliably, cost-effectively and environmentally to customers are covered. Major distribution network configurations together with the associated protection systems adopted by reputable power companies worldwide for ensuring supply reliability and operational flexibility are also included. Strategies for enhancing supply reliability and power quality, as well as meter revenue loss prevention techniques are also examined.

Whilst the course is most valuable to practising electrical engineers, it also furnishes engineers of other trades with background knowledge for coordinating their work with counterparts engaged in power supply industry as well as building services engineering field.

ELEC6063. Optoelectronics and lightwave technology (6 credits)

The aim of this course is to broaden the knowledge in the hardware of in optical communication systems from optoelectronic devices to integrated optical network.

Optical communication system has almost become a “must” technique in data/signal transmission (i.e. fiber to home). Students will have the ability to address the issues:
(i) what optoelectronic components are required in the system and the operation principles and device physics,
(ii) the issues that have been be considered to build a optical network by using the optoelectronic components
(iii) to evaluate the performance of the optical network to meet the target/budget (technical) and to improve the performance (using advanced technology).
All the issues will be discussed in this course.

ELEC6065. Data compression (6 credits)

This course provides an introduction to the state-of-the-art compression techniques for typical media including files, digital images, videos and audios. Specifically, the course will discuss in detail about the coding and quantization techniques commonly used for images, videos and audios. Finally, the course will cover basic concept and terminologies of common image, video and audio standards.

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

With advances in engineering and computing, an extraordinary body of imaging technologies and applications has developed over the last 25 years. Among the various in vivo imaging modalities available or under development today, magnetic resonance imaging (MRI) is one of the most versatile and valuable one.

This course is basically divided into two parts, covering a variety of MR related topics in detail. The first part of the course will focus on the fundamental principles and hardware of MRI while the second part will be on the advanced MRI applications.

At the end of the course, students should gain a thorough understanding in the principles of MRI and MR systems. They will also learn the latest state-of-the-art applications of MRI in research and clinical practices.

Pre-requisite: Introductory course in physics or electromagnetism

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ELEC6079. Biomedical ultrasound (6 credits)

This is a first course on the technical aspect of biomedical ultrasound, and it is designed for senior-level MedE undergraduates. We will cover the physical principles behind ultrasound, its medical imaging modes, and its therapeutic usages. There will be opportunity for students to learn how to operate an ultrasound imaging system.

There are two major aims for this course. First, it aims to provide students with a top-down technical overview on ultrasound and its biomedical applications. Second, it aims to equip students with hands-on experience in operating an ultrasound scanner.

ELEC6080. Telecommunications systems and management (6 credits)

This course aims to provide a comprehensive understanding of major telecommunications systems (i.e. fixed, mobile, wireless, etc.), and contemporary management practices (e.g. strategy planning, product development, marketing, customer service, etc.) in telecommunications systems. It helps students to appreciate the integration of multi-disciplinary knowledge in telecommunications sectors.

The course also covers some more advanced topics in the ICT industry including next generation networks (e.g. NGA such as FTTx, HSPA+/4G/LTE, HetNet, etc.), convergence development (i.e. device, network, service, sector, etc.), multiple-play and OTT services.

ELEC6081. Biomedical signals and systems (6 credits)

This course aims at introducing the origins, characteristics, analyses and clinical applications of the most common and clinically important medical signals, including electrocardiography (ECG), electromyography (EMG), electroencephalography (EEG), etc. Application-oriented biomedical signal processing and pattern recognition techniques will be introduced, ranging from the very basic methods (e.g., Fourier transform) to advanced methods (e.g.,neural network). With the aid of in-depth case studies, the course offers practical guidance on how to choose appropriate processing methods for solving specific problems of biomedical research. Recent developments and the state-of-the-art of biomedical signals and systems, such as brain-computer interface, will also be discussed.

ELEC6084. Power delivery management for metropolitan cities (6 credits)

This course provides a platform for electrical engineers to strengthen their technical expertise in power delivery in metropolitan cities from design to application at an advanced level. State-of-the-art technologies for safe, reliable, cost-effective and environmentally-friendly power delivery to customers are covered. Major power delivery network designs together with the associated protection systems adopted by reputable power companies worldwide for ensuring supply reliability and operational effectiveness are also included. Strategies for loss prevention management, enhancement of supply reliability and power quality are also examined.

Whilst the course is most valuable to practising electrical engineers, it also furnishes engineers of other related disciplines with necessary engineering knowledge for coordinating their work with counterparts engaged in power supply industry as well as building services engineering field.

ELEC6085. The role of a computerized SCADA system in power system operation (6 credits)

This course aims at introducing the methodologies for designing a Computerized Supervisory Control and Data Acquisition (SCADA) system for power system control and automation. The course will start with an introduction to basic power system operations for ensuring secure & effective power generation, transmission & distribution and how SCADA systems can help. Then the basic functions of a SCADA system will be analyzed and described. This is followed by automatic functions which can be implemented for power systems to enhance performance, reliability and economy. After that the software structure of various subsystems in a SCADA system will be explained. Finally, techniques for enhancing SCADA system performance and reliability will be introduced.

ELEC6092. Green project management (6 credits)

This course aims at introducing Green Project Management. By giving a brief account on the environmental issues, the course will begin by explaining the scope and value of green projects. It will illustrate the importance of clarity of mission and goals of green projects; and how these could be done by means of audit and feasibility study. It will also describe how green project planning and control can be implemented with proper system tools. The basic theory regarding contract management: project strategy, contract documents, tendering procedure and contingency shall be introduced. It will also give examples of site implementation: partnership collaboration; project quality assurance; safety management; environmental issues and risk management. The course shall be concluded by detailing project quality assurance; safety management.

ELEC6095. Smart grid (6 credits)

This course aims at providing fundamental knowledge of various smart grid technologies. The challenges of the future electric power grid, renewable energy integration, energy utilization, energy storage system, automation and communication technologies in smart grid will be covered. Topics on the smart devices/applicances and energy saving control are included.

Mutually exclusive with: ELEC6096, MEBS6018

ELEC6097. IP Networks (6 credits)

This course aims at enabling detailed understanding about how the Internet works. The course will begin by focusing on the fundamental concepts in the Internet architecture. This is followed by detailed examinations of the key protocols at application layer, transport layer, network layer, and link layer.

Mutually exclusive with: ELEC6007, ELEC7144

ELEC6098. Electronic and mobile commerce (6 credits)

This course aims at introducing both technical, commercial and managerial knowledge on electronic commerce and mobile. The course will start with an introduction to the Business-to-Consumer (B2C) Model; Business-to- Business (B2B) model, followed by an overviews of different enabling technologies for electronic commerce and mobile commerce such as the location base technology, RFID, GPS, mobile network, electronic payment, server-side and channel security, Near Field Communication, QR Code, augmented reality and other latest technologies deploying in the industry. By the end of the course, the research trend and the way forward of the industry will be discussed.

Mutually exclusive with: ELEC6078, ELEC6086

ELEC6099. Wireless communications and networking (6 credits)

5G refers to the fifth generation wireless technologies for digital cellular networks that began wide deployment in 2019. This course aims at introducing the core principles and technologies for 5G communications and networking. The first half focuses on basic concepts and techniques including including radio propagation, digital modulation, Orthogonal Frequency Division Multiplexing (OFDM), Multiple-Input-Multiple-Output (MIMO) Communication. The second half provides a comprehensive introduction to 5G covering physical layer (PHY) technologies, millimetre wave (mmWave) communications, network virtualization and slicing, provides an introduction to different types of networks including cellular networks, satellite communication networks, narrow-band Internet-of-Things (NB-IoT).

Mutually exclusive with: ELEC6040, ELEC6071, ELEC6087

ELEC6100. Digital Communications (6 credits)

This course aims at enabling the fundamental understanding of the digital communication systems. After an overview on basic probability and random processes, the course will cover the modulation and demodulation. Then, performance analyses under additive white Gaussian noise channel and fading channel are examined. This is followed by topics on spatial diversity and channel equalization.

Mutually exclusive with: ELEC6014 and ELEC6045

ELEC6103. Satellite communications (6 credits)

This course is an introduction to satellite communications taught at a level appropriate for postgraduates reading for the MSc curriculum in electrical and electronic engineering. It is aimed at providing a general understanding and an overview on satellite communications, with emphasis on the recent applications and developments

The following topics will be covered: basics of satellite communications system: orbital aspects, launching, link budgets, modulation, error control coding, and multiple access, earth station, very small aperture terminals (VSATs), global positioning system (GPS) and satellites for mobile communication.

At the end of the course, students should have gained a general understanding on satellite communications systems and also recent applications and developments of satellite communications.

ELEC6105. Magnetics engineering for data storage and emerging applications (6 credits)

Magnetics supports a gigantic commercial market valued at over US$100 billion per year worldwide. A wide range of industries utilizing magnetics-based technologies require highly skilled magnetics engineers. This course is designed to provide knowledge and expertise in the field of magnetic engineering, which is vital to a number of industrial sectors including the data storage, computers, health & medical, advanced materials, non-destructive testing, transport & aerospace, energy generation and distribution, and power industries. The Nobel Prize in Physics 2007 was awarded to a new magnetics engineering regime – spintronics. It combines magnetism (electron spin) and microelectronics (charge transport) whereby spin of the electrons adds a new dimension to the practice of electronics. This new discovery opens up innovative designs and products for data storage and other emerging applications.

This course will start with the fundamentals of magnetism and magnetic materials, and then more in-depth topics such as ferromagnetism and exchange, antiferromagnetism and magnetic order, micromagnetism, domains, hysteresis, and nanoscale magnetism. Students will learn engineering techniques in characterizing magnetic properties and analyzing magnetic systems. The applications of soft and hard magnetic materials in transformers, magnetometers, chokes, microwave applications, motors, generators, actuators, magnetic separation, holding magnets, etc., will be discussed. Students will also learn how and why a hard disk drive (HDD) functions. The second part of this course will focus on spintronics. Students will know how different spintronic devices work and will be able to analyze giant magnetoresistance (GMR) and tunneling magnetoresistance (TMR) devices. A special emphasis will be made on spintronic sensors and their innovative emerging applications in future spin-based data storage, power industries, health care, non-destructive testing, and others.

Pre-requisite: This course will be given at the level suitable for graduate and senior undergraduate students in electrical and electronic engineering, physics, materials science, or another relevant science or engineering discipline.

ELEC6106. From AI software to hardware: an introduction of machine learning and EDA (6 credits)

This introductory course covers two topics: basic machine learning and basic Electronic Design Automation (EDA) for Very Large Scale Integration (VLSI). The first part starts from the basic concepts and fundamentals of deep learning, including machine learning basics, deep neural networks, back-propagation, activation functions, loss functions and regularizations. Then deep learning methods are applied to a few tasks in computer vision (handwritten digits recognition) and natural language processing (name generation). Finally, successful applications and hot research directions in deep learning are showcased. The second part starts with the VLSI realization of AI and EDA design flow. It then focuses on an important component in EDA, the SPICE circuit simulation. Various SPICE simulation concepts and models (netlist, MNA, compact models) are introduced. A series of numerical methods (linear system solution, Newton's method, backward Euler and matrix exponential method) to solve the linear and nonlinear SPICE problems are then investigated, followed by an introduction of future trends in the fields.

- Introduce the basic concepts and fundamentals of machine learning.
- Introduce a popular deep learning framework and some simple tasks that can be solved with deep learning.
- Introduce possible research directions of machine learning.
- Introduce fundamental knowledge of hardware realization of AI & EDA.
- Teach basic models and algorithms for circuit simulation.
- Introduce future topics in AI hardware & EDA.

ELEC6601. Industrial marketing (6 credits)

This course covers the following topics: Business to business marketing; value chain; character of industrial marketing; marketing opportunities; marketing strategies; channel relationships; sales and sales management; marketing communications; customer programs; business ethics; and crisis management.

By means of problem-based learning, case studies, guest induction, team interaction and lectures, a student shall improve feeling of industrial marketing models; along with understanding of underlying practices and business concepts. The student shall acquire skill and proficiency through the projects and presentations. He shall be able to apply concepts, and where possible, be able to develop innovative models for potential applications.

ELEC6602. Business venture in China (6 credits)

This course covers the following topics: China economic landscape briefing; foreigner's perception on China; absolute advantages of overseas and SAR Chinese; forms of ventures; business competition; modeling negotiation; building successful ventures in China.

By means of problem-based learning, case studies, team interactions, opportunity visits and lectures, a student shall improve understanding of business channels and niches in China. The student shall acquire skill and proficiency through the projects and presentations. He shall be able to apply concepts and to develop business venture models for himself or potential entrants under the present circumstances.

ELEC6603. Success in industrial entrepreneurship (6 credits)

This course covers the following topics: Framework for entrepreneurship; identifying resources, capabilities, environments, opportunities and strategies; business plan; financing the new venture; risk balancing and staged financing; creating an organization.

By means of problem-based learning, case studies, guest induction, team interaction and lectures, a student shall improve feeling of entrepreneurship and new opportunities; along with understanding of successful models and business concepts. The student shall acquire skill and proficiency through the projects and presentations. He shall be able to apply concepts and to elaborate successful opportunities and extend them to potential applications.

ELEC6604. Neural networks, fuzzy systems and genetic algorithms (6 credits)

This course provides a general introduction to neural networks, fuzzy systems and genetic algorithms. The fundamental concepts and techniques of these three areas will be given. The course will also provide examples on the application of neural networks, fuzzy systems and genetic algorithms to a

variety of engineering problems. This course will cover three important topics in the field of Applied Artificial Intelligence. By the end of this course, student should possess a firm grounding in the concepts and techniques of neural network, fuzzy system and genetic algorithm. The student should be able to apply the acquired knowledge to the development of intelligent systems or to the exploration of research problems.

ELEC7021. Dissertation (24 credits)

This course aims at providing the in-depth training in conducting an individual design/research project at the master level.

The essence of the dissertation is for the student to embark on a research and development project on a specific topic agreed upon by the respective supervisor and endorsed by the Head. The aims of the project are not limited to technical achievement, but also reflected on self-awareness, self-management and probing the limitation of oneself.

ELEC7022. Project (12 credits)

The aim of the project is to provide an opportunity for the student to apply what they have learnt from classes to conduct an individual design project in a specific topic related to their profession to be agreed upon by the respective supervisor and endorsed by the Head. The objectives of the project are not limited to technical achievement, but also reflected on self-awareness, self-management and probing the limitation of oneself. Another objective is to make the learning experience inclusive, enjoyable, and career beneficial.

Upon supervision by the teacher, the student will develop skills through individually carrying out the Project Requirement and Design, Implementation and Evaluation, Report and Presentation on the designated project. Students are encouraged to explore and make suggestions on the direction of the project over the project development process. The project supervisor shall provide assistance and aids along each phase in the project development process with the student.

Each project student is generally required to have meetings and discussions with his/her supervisors on a regular basis. Mid-term Review will be held with both the supervisors and the 2nd examiner in order to review the student's progress. The final assessment will be based on Project Report, Presentation, and Demonstration.

ELEC7051. Advanced topics in communication theory and systems (6 credits)

This course covers advanced topics in communication theory and systems. The first part of the course focuses on MIMO communication that is the major breakthrough in modern communication theory and a key enabler of high-speed access in 3GPP LTE and WiFi networks. A wide range of relevant topics will be discussed including MIMO channel modeling, MIMO information theory, spatial multiplexing, space time coding, limited feedback, multiuser MIMO and multiuser diversity. In the second part of the course, we will study theories and techniques for orthogonal frequency division multiplexing (OFDM) and spread spectrum communication. The course concludes with cellular system designs where we will discuss multi-cell cooperation, dynamic resource allocation and analyze the system performance.

ELEC7077. Advanced topics in multimedia signals and systems (6 credits)

The course covers core and selected topics in multimedia signals and systems.

ELEC7078. Advanced topics in electrical and electronic engineering (6 credits)

To study timely advanced topics and issues of special current interest in some fields of electrical and electronic engineering.

ELEC7079. Investment and trading for engineering students (6 credits)

This course is designed for engineering students who wish to start a career in the financial industry. This course helps students to develop the basic knowledge, skill sets, and vocabulary that can communicate with the practitioners in financial industry. Students are expected to learn how to develop market view by analyzing the driving factors to forecast the movement of financial assets like equities and foreign exchange. Students will learn various financial instruments and quantitative models to support the development of investment and trading strategies. The financial instruments will be covered in this course include: options, futures and other derivatives of equities, commodities, and foreign exchanges as well as their pricing models. Investment and trading strategies that will be discussed in this course include those that commonly used in the market, for example, VWAP, TWAP, Bollinger Band, and RSI.

Mutually exclusive with: COMP7802 Introduction to financial computing

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ELEC7080. Algorithmic trading and high frequency trading (6 credits)

Program trading, which includes high frequency trading (HFT), has become important that it generated over sixty percent of trading volume at Nasdaq and NYSE. There are wide range of issues involved in program trading process, which include opportunities identification, cost/friction estimation, market impact estimation, trading strategies selection, trade scheduling, capital and liquidity management, risk management, and exit management. In this course we will review the foundations of securities trading and discuss issues that related to the market microstructure. We will review important models in the microstructure and present mathematical tools in their structural and statistical representations. We will also discuss the costs associated with trading, how these costs are measured and strategies that minimize them, including the study of models for optimal splitting of the orders across time, to reduce transaction costs and control the temporary and permanent price adjustments that result from trades. "Is that possible to use HFT in China or Hong Kong equities, options, or futures markets?" was a question that constantly been asked by practitioners and we will search for the answer together.

Pre-requisite: ELEC7079 Investment and trading for engineering students

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ELEC7081. Advanced topics in computational finance (6 credits)

This course aims to introduce finance to engineering students. Students will be introduced research that shape the frontier in finance industry.

By the end of this course, students should know what computational finance is. They should be able to realize business potentials that arise from advances in computing (the business perspective). They should also understand where in finance computational methods could be applied to (the technology perspective). They should understand what computation methods are most used in finance. They should understand the synergy between computation and finance.

Mutually exclusive with: ELEC7082 Artificial intelligence in finance

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ELEC7082. Artificial intelligence in finance (6 credits)

This course aims to introduce finance to engineering students. Students will be introduced research, in particular artificial intelligence (AI) that shape the frontier in finance industry.

By the end of this course, students should know what computational finance is. They should be able to realize business potentials that arise from advances in computing (the business perspective). They should also understand where in finance AI methods could be applied to (the technology perspective). They should understand what AI methods are most used in finance. They should understand the synergy between computation and finance.

Mutually exclusive with: ELEC7081 Advanced topics in computational finance

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ELEC7402. Advanced electric vehicle technology (6 credits)

This course aims at providing in-depth understanding of the latest technologies of electric vehicles (EVs), with emphasis on their system configurations, propulsion systems, energy systems, and development trends.

Specifically, the course covers the following topics: latest EV system concepts and designs, advanced electric machines and drives for EVs, advanced hybrid powertrains for hybrid EVs, advanced EV energy sources and energy management systems, and EV-to-grid technology.

ELEC7403. Advanced power electronics (6 credits)

The aim of this course is to provide students with an understanding of advanced subject matters in power electronics, which include (i) high-frequency switching converters; (ii) dynamics and control of switching converters; (iii) modeling of switching converters; (iv) components and devices; and (v) industrial requirements. Students enrolled in the course are expected to have prior understanding of basic power electronic principles and the operations of rectifier and phase controlled circuits, and DC/DC buck, boost, buck-boost, and Cuk converters, and knowledge of basic power devices such as power transistor, power MOSFET, and IGBT.

ELEC7404. Advanced railway engineering (6 credits)

The aim of this course is to provide students with an understanding of advanced subject matters in railway engineering, which include (i) railway operations; (ii) rolling stock; (iii) railway traction supply systems; (iv) signaling system;(v) railway infrastructures; and (vi) railway business management. Students enrolled in the module are expected to have prior understanding of basic electrical engineering and power electronic principles, the operations of AC and DC circuits, rectifier and phase controlled circuits.

ELEC7456. Advanced power system operation (6 credits)

The course discusses advanced operation methodology and control theory for modern power systems. A rigorous treatment will be adopted for practical power system operation issues, including supply demand balance, plant scheduling and unit commitment, automatic generation control and economic dispatch, load flow and fault level control, voltage and stability control, security assessment and operational planning, protection and communication system, process control system and real time control, switching operation and operational safety, emergency preparedness and black start strategy, and power system deregulation and open market's impact to system operation.

The course aims at providing students an in depth appreciation of the major issues in power system operation, thorough understanding of the concepts and principles to operate the system, and the ability to mastering the strategy and methodology to tackle these issues with clear objectives to ensure safety, security and efficiency of the entire power system.

ELEC7466. Advanced topics in power system engineering (6 credits)

This course aims at enabling detailed understanding about specific topics and issues of special current interest in power system engineering. In particular, by analysing how recent large system blackouts had occurred and the reasons leading to such incidents. The course will begin by focusing on the fundamental concepts in power system design and planning, operation and equipment choice. Special topics on issues and problem areas in network configuration, short circuit level coordination, generator design, power system stability, reactive power compensation and voltage control will be discussed.

The course also covers some advanced topics in practical issues in power system control in a modern power system control centre as well as discusses observations and different viewpoints about open power market operation in the Electricity Supply Industry.

ELEC7900. Engineering and society (6 credits)

Students who fulfill the requirements of this workshop will be able to understand his professional role in the society and how he/she should contribute to it. The course is a workshop platform for interaction among potential engineering professionals on topics related to professional conduct, social responsibility, sustainability and safety issues, technology and environment, as well as professional ethics. Legal foundation topics such as contract, intellectual property, tort, professional negligence will be introduced.

(This course will not be counted for the fulfilment of the curriculum requirements and the classification of award of the degree.)

MEBS6001. Electrical installations (6 credits)

This course covers the following topics: 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; electrical safety; distribution transformers; switchgear and fuses; motor control gears; selection of electrical equipment and conductors; lightning protection.

MEBS6019. Extra-low-voltage electrical systems in buildings (6 credits)

This course focuses on extra-low-voltage electrical systems: roles, transmission medium and network, modeling, fixed and movable system; types. Applications in building services: electrical safety; public address system, communication, cable and satellite television, conference and interpretive system, audio and visual system; service integration and automation; system monitoring. Applications in property management: fire and life-saving management equipment, electronic patrol, car park management, efficiency management, CCTV, security system, access and security control, electronic receptionist. Disturbance; electromagnetic interference and protective measures.

Subject to Approval

MSc in EEE- (2020-2021) V1:20200326

SYLLABUS FOR THE DEGREE OF MASTER OF SCIENCE IN ENGINEERING IN ELECTRICAL AND ELECTRONIC ENGINEERING
MSC(ENG)(EEE)

(This syllabus is applicable to students admitted to the curriculum in the academic years 2016-17, 2017-18, 2018-19)

Definition and Terminology

Discipline course – any course on a list of courses in the discipline of curriculum which a candidate must pass at least a certain number of credits as specified in the Regulations.

Elective course – any course offered by the Departments of the Faculty of Engineering for the fulfilment of the curriculum requirements of the degree of MSc(Eng) in Electrical and Electronic Engineering that are not classified as discipline courses.

Capstone Experience# – a 24-credit dissertation which is a compulsory and integral part of the curriculum.

Curriculum Structure

Candidates are required to complete 72 credits of courses as set out below, normally over one academic year of full-time study or two academic years of part-time study:

Course Category	No. of Credits
Discipline Courses	Not less than 30
Elective Courses	Not more than 18
Capstone Experience#	24
Total	72

Candidates shall select courses in accordance with the regulations of the degree. Candidates must complete 8 courses and a dissertation. They may select no more than 3 courses from the other taught postgraduate curricula in the Faculty of Engineering as electives. All course selection will be subject to approval by the Course Coordinators.

Candidates are required to follow the prescribed curriculum of one of the three streams: General Stream, Communications Engineering and Power Engineering, each comprising a 24-credit dissertation and at least 5 discipline courses selected from subject group A, B or C. To qualify as a graduate of the Communications Engineering Stream, candidates must pass at least 5 discipline courses in the Communication Engineering subject group. To qualify as a graduate of the Power Engineering Stream, candidates must pass at least 5 discipline courses in the Power Engineering subject group. For the General Stream, candidates may choose from any of the three subject groups. The Department also offers an optional course in the Professional Development subject group, namely ELEC7900 Engineering and society, which will not be counted for the fulfilment of the curriculum

requirements and the classification of award of the degree

 # Special approval has been given by the Senate for candidates admitted to curriculum in the academic year 2016-17 to take additional discipline courses of the same credit value in lieu of the capstone experience to satisfy the curriculum requirements.

The following is a list of discipline courses offered by the Department of Electrical and Electronic Engineering. The list below is not final and some courses may not be offered every year.

All courses are assessed through examination and / or coursework assessment, the weightings of which are subject to approval by the Board of Examiners.

Subject Groups

A. General

ELEC6008	Pattern recognition and machine learning
ELEC6027	Integrated circuit systems design
ELEC6036	High performance computer architecture
ELEC6043	Digital image processing
ELEC6049	Digital system design techniques
ELEC6063	Optoelectronics and lightwave technology
ELEC6067	Magnetic resonance imaging (MRI) technology and applications
ELEC6079	Biomedical ultrasound
ELEC6081	Biomedical signals and systems
ELEC6092	Green project management
ELEC6105	Magnetics engineering for data storage and emerging applications
ELEC6106	From AI software to hardware: an introduction of machine learning and EDA
ELEC6601	Industrial marketing
ELEC6602	Business venture in China
ELEC6603	Success in industrial entrepreneurship
ELEC6604	Neural networks, fuzzy systems and genetic algorithms
ELEC7078	Advanced topics in electrical and electronic engineering
ELEC7079	Investment and trading for engineering students
ELEC7080	Algorithmic trading and high frequency trading
ELEC7081	Advanced topics in computational finance
ELEC7082	Artificial intelligence in finance

B. Communications Engineering

ELEC6006	Communications policy and regulations
ELEC6026	Digital signal processing
ELEC6065	Data compression
ELEC6080	Telecommunications systems and management
ELEC6097	IP networks
ELEC6098	Electronic and mobile commerce
ELEC6099	Wireless communications and networking
ELEC6100	Digital communications
ELEC6103	Satellite communications
ELEC7051	Advanced topics in communication theory and systems
ELEC7077	Advanced topics in multimedia signals and systems

C. Power Engineering

ELEC6055	Power system distribution
ELEC6084	Power delivery management for metropolitan cities
ELEC6085	The role of a computerized SCADA system in power system operation
ELEC6095	Smart grid
ELEC7402	Advanced electric vehicle technology
ELEC7403	Advanced power electronics
ELEC7404	Advanced railway engineering
ELEC7456	Advanced power system operation
ELEC7466	Advanced topics in power system engineering
MEBS6001	Electrical installations
MEBS6019	Extra-low-voltage electrical systems in buildings

D. Professional Development

ELEC7900	Engineering and society (This course will not be counted for the fulfilment of the curriculum requirements and the classification of award of the degree.)

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

All courses are assessed through examination and/or coursework assessment.

ELEC6006. Communications policy and regulations (6 credits)

This course aims to provide a comprehensive understanding of Communications Policy and Regulations, and latest ICT policy and regulatory practices in the leading markets and economies. It helps students to appreciate the integration of multi-disciplinary knowledge in ICT industry.

The course also covers some advanced policy & regulatory topics in the ICT industry including convergence licensing regime, co-regulation/self-regulation, and consumer protection regulation.

ELEC6008. Pattern recognition and machine learning (6 credits)

This course aims at providing fundamental knowledge on the principles and techniques of pattern recognition and machine learning.

Specifically, the course covers the following topics: Bayes decision theory; parametric and non-parametric methods; linear discriminant functions; unsupervised learning and clustering; feature extraction; neural networks; context-dependent classification; case studies.

Pre-requisite: A good background in linear algebra, programming experience.

Mutually exclusive with: COMP7504 Pattern recognition and applications

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ELEC6026. Digital signal processing (6 credits)

This course provides an introduction to the fundamental concepts of digital signal processing (DSP) including a wide variety of topics such as discrete-time linear-time invariant systems, sampling theorem, z-transform, discrete-time/discrete Fourier transform, and digital filter design. Furthermore, the course

will also discuss in detail about other advanced topics in digital signal processing such as multidimensional signals and systems, random processes and applications, and adaptive signal processing.

ELEC6027. Integrated circuit systems design (6 credits)

This course covers the following topics: 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.

ELEC6036. High-performance computer architecture (6 credits)

This course aims at providing an in-depth understanding of the principles, architectures and implementations of modern high performance computer systems which are designed and based on the proactive use of instruction-level parallelism (ILP). Specifically, the course discusses with examples and case studies to investigate the high-performance computing models; pipelining and ILP; advanced pipelining design including the scoreboard and Tomasulo algorithm; speculative execution; advanced computing models such as the cloud computing models and their possible uses in general, scientific or financial applications; and case studies like the Amazon EC2 and Google Cloud platforms.

ELEC6043. Digital image processing (6 credits)

This course deals with the theory, techniques and applications of digital image processing, which includes characterization, enhancement, restoration, feature extraction, representation, description and classification, advance topics in image analysis, image motion, and application case studies.

Specifically, it covers the areas of image acquisition and imaging systems, 2D continuous-time and discrete-time signals and systems, time and frequency representations, sampling and quantization issues, image filtering, convolution and enhancement, image reconstruction and restoration, image quality evaluation, image transform and compression, geometric feature extraction, image representation and description, image analysis, motion and case studies.

Prerequisite: Exposure to signals and systems at the level of ELEC3241

ELEC6049. Digital system design techniques (6 credits)

This course aims to provide a structured approach to digital system design. Fundamental to this is an understanding of the underlying technologies for modern day digital systems and the methods of analysis. Systematic design methodology and computer aids are crucial to tackling systems of increasing complexity. Selected design issues (such as faults, testability) will also be presented where appropriate.

The course begins with an overview of digital technologies, their evolution and the implication on design realization. Students are updated on fundamental theories and essential building blocks to prepare them for higher level systems design. A structured approach is used to quickly guide students from basic combinational logic to more complex digital systems such as RTL or programmable processors. Design tradeoffs and optimizations are emphasized as an integral part of the design process.

The course also covers hardware description language (Verilog) as a high level design tool. Where resources allow, students will have the chance of gaining experience on the use of Verilog.

ELEC6055. Power system distribution (6 credits)

This course provides a platform for electrical engineers to strengthen their technical expertise in power distribution from design to application at an advanced level. State-of-the-art technologies for distributing electricity safely, reliably, cost-effectively and environmentally to customers are covered. Major distribution network configurations together with the associated protection systems adopted by reputable power companies worldwide for ensuring supply reliability and operational flexibility are also included. Strategies for enhancing supply reliability and power quality, as well as meter revenue loss prevention techniques are also examined.

Whilst the course is most valuable to practising electrical engineers, it also furnishes engineers of other trades with background knowledge for coordinating their work with counterparts engaged in power supply industry as well as building services engineering field.

ELEC6063. Optoelectronics and lightwave technology (6 credits)

The aim of this course is to broaden the knowledge in the hardware of in optical communication systems from optoelectronic devices to integrated optical network.

Optical communication system has almost become a “must” technique in data/signal transmission (i.e. fiber to home). Students will have the ability to address the issues:
(i) what optoelectronic components are required in the system and the operation principles and device physics,
(ii) the issues that have been be considered to build a optical network by using the optoelectronic components
(iii) to evaluate the performance of the optical network to meet the target/budget (technical) and to improve the performance (using advanced technology).
All the issues will be discussed in this course.

ELEC6065. Data compression (6 credits)

This course provides an introduction to the state-of-the-art compression techniques for typical media including files, digital images, videos and audios. Specifically, the course will discuss in detail about the coding and quantization techniques commonly used for images, videos and audios. Finally, the course will cover basic concept and terminologies of common image, video and audio standards.

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

With advances in engineering and computing, an extraordinary body of imaging technologies and applications has developed over the last 25 years. Among the various in vivo imaging modalities available or under development today, magnetic resonance imaging (MRI) is one of the most versatile and valuable one.

This course is basically divided into two parts, covering a variety of MR related topics in detail. The first part of the course will focus on the fundamental principles and hardware of MRI while the second part will be on the advanced MRI applications.

At the end of the course, students should gain a thorough understanding in the principles of MRI and MR systems. They will also learn the latest state-of-the-art applications of MRI in research and clinical practices.

Pre-requisite: Introductory course in physics or electromagnetism

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ELEC6079. Biomedical ultrasound (6 credits)

This is a first course on the technical aspect of biomedical ultrasound, and it is designed for senior-level MedE undergraduates. We will cover the physical principles behind ultrasound, its medical imaging modes, and its therapeutic usages. There will be opportunity for students to learn how to operate an ultrasound imaging system.

There are two major aims for this course. First, it aims to provide students with a top-down technical overview on ultrasound and its biomedical applications. Second, it aims to equip students with hands-on experience in operating an ultrasound scanner.

ELEC6080. Telecommunications systems and management (6 credits)

This course aims to provide a comprehensive understanding of major telecommunications systems (i.e. fixed, mobile, wireless, etc.), and contemporary management practices (e.g. strategy planning, product development, marketing, customer service, etc.) in telecommunications systems. It helps students to appreciate the integration of multi-disciplinary knowledge in telecommunications sectors.

The course also covers some more advanced topics in the ICT industry including next generation networks (e.g. NGA such as FTTx, HSPA+/4G/LTE, HetNet, etc.), convergence development (i.e. device, network, service, sector, etc.), multiple-play and OTT services.

ELEC6081. Biomedical signals and systems (6 credits)

This course aims at introducing the origins, characteristics, analyses and clinical applications of the most common and clinically important medical signals, including electrocardiography (ECG), electromyography (EMG), electroencephalography (EEG), etc. Application-oriented biomedical signal processing and pattern recognition techniques will be introduced, ranging from the very basic methods (e.g., Fourier transform) to advanced methods (e.g.,neural network). With the aid of in-depth case studies, the course offers practical guidance on how to choose appropriate processing methods for solving specific problems of biomedical research. Recent developments and the state-of-the-art of biomedical signals and systems, such as brain-computer interface, will also be discussed.

ELEC6084. Power delivery management for metropolitan cities (6 credits)

This course provides a platform for electrical engineers to strengthen their technical expertise in power delivery in metropolitan cities from design to application at an advanced level. State-of-the-art technologies for safe, reliable, cost-effective and environmentally-friendly power delivery to customers are covered. Major power delivery network designs together with the associated protection systems adopted by reputable power companies worldwide for ensuring supply reliability and operational effectiveness are also included. Strategies for loss prevention management, enhancement of supply reliability and power quality are also examined.

Whilst the course is most valuable to practising electrical engineers, it also furnishes engineers of other related disciplines with necessary engineering knowledge for coordinating their work with counterparts engaged in power supply industry as well as building services engineering field.

ELEC6085. The role of a computerized SCADA system in power system operation (6 credits)

This course aims at introducing the methodologies for designing a Computerized Supervisory Control and Data Acquisition (SCADA) system for power system control and automation. The course will start with an introduction to basic power system operations for ensuring secure & effective power generation, transmission & distribution and how SCADA systems can help. Then the basic functions of a SCADA system will be analyzed and described. This is followed by automatic functions which can be implemented for power systems to enhance performance, reliability and economy. After that the software structure of various subsystems in a SCADA system will be explained. Finally, techniques for enhancing SCADA system performance and reliability will be introduced.

ELEC6092. Green project management (6 credits)

This course aims at introducing Green Project Management. By giving a brief account on the environmental issues, the course will begin by explaining the scope and value of green projects. It will illustrate the importance of clarity of mission and goals of green projects; and how these could be done by means of audit and feasibility study. It will also describe how green project planning and control can be implemented with proper system tools. The basic theory regarding contract management: project strategy, contract documents, tendering procedure and contingency shall be introduced. It will also give examples of site implementation: partnership collaboration; project quality assurance; safety management; environmental issues and risk management. The course shall be concluded by detailing project quality assurance; safety management.

ELEC6095. Smart grid (6 credits)

This course aims at providing fundamental knowledge of various smart grid technologies. The challenges of the future electric power grid, renewable energy integration, energy utilization, energy storage system, automation and communication technologies in smart grid will be covered. Topics on the smart devices/applicances and energy saving control are included.

Mutually exclusive with: ELEC6096, MEBS6018

ELEC6097. IP Networks (6 credits)

This course aims at enabling detailed understanding about how the Internet works. The course will begin by focusing on the fundamental concepts in the Internet architecture. This is followed by detailed examinations of the key protocols at application layer, transport layer, network layer, and link layer.

Mutually exclusive with: ELEC6007, ELEC7144

ELEC6098. Electronic and mobile commerce (6 credits)

This course aims at introducing both technical, commercial and managerial knowledge on electronic commerce and mobile. The course will start with an introduction to the Business-to-Consumer (B2C) Model; Business-to- Business (B2B) model, followed by an overviews of different enabling technologies for electronic commerce and mobile commerce such as the location base technology, RFID, GPS, mobile network, electronic payment, server-side and channel security, Near Field Communication,

QR Code, augmented reality and other latest technologies deploying in the industry. By the end of the course, the research trend and the way forward of the industry will be discussed.

Mutually exclusive with: ELEC6078, ELEC6086

ELEC6099. Wireless communications and networking (6 credits)

5G refers to the fifth generation wireless technologies for digital cellular networks that began wide deployment in 2019. This course aims at introducing the core principles and technologies for 5G communications and networking. The first half focuses on basic concepts and techniques including radio propagation, digital modulation, Orthogonal Frequency Division Multiplexing (OFDM), Multiple-Input-Multiple-Output (MIMO) Communication. The second half provides a comprehensive introduction to 5G covering physical layer (PHY) technologies, millimetre wave (mmWave) communications, network virtualization and slicing, provides an introduction to different types of networks including cellular networks, satellite communication networks, narrow-band Internet-of-Things (NB-IoT).

Mutually exclusive with: ELEC6040, ELEC6071, ELEC6087

ELEC6100. Digital Communications (6 credits)

This course aims at enabling the fundamental understanding of the digital communication systems. After an overview on basic probability and random processes, the course will cover the modulation and demodulation. Then, performance analyses under additive white Gaussian noise channel and fading channel are examined. This is followed by topics on spatial diversity and channel equalization.

Mutually exclusive with: ELEC6014 and ELEC6045

ELEC6103. Satellite communications (6 credits)

This course is an introduction to satellite communications taught at a level appropriate for postgraduates reading for the MSc curriculum in electrical and electronic engineering. It is aimed at providing a general understanding and an overview on satellite communications, with emphasis on the recent applications and developments

The following topics will be covered: basics of satellite communications system: orbital aspects, launching, link budgets, modulation, error control coding, and multiple access, earth station, very small aperture terminals (VSATs), global positioning system (GPS) and satellites for mobile communication.

At the end of the course, students should have gained a general understanding on satellite communications systems and also recent applications and developments of satellite communications.

ELEC6105. Magnetics engineering for data storage and emerging applications

Magnetics supports a gigantic commercial market valued at over US$100 billion per year worldwide. A wide range of industries utilizing magnetics-based technologies require highly skilled magnetics engineers. This course is designed to provide knowledge and expertise in the field of magnetic

engineering, which is vital to a number of industrial sectors including the data storage, computers, health & medical, advanced materials, non-destructive testing, transport & aerospace, energy generation and distribution, and power industries. The Nobel Prize in Physics 2007 was awarded to a new magnetics engineering regime – spintronics. It combines magnetism (electron spin) and microelectronics (charge transport) whereby spin of the electrons adds a new dimension to the practice of electronics. This new discovery opens up innovative designs and products for data storage and other emerging applications.

This course will start with the fundamentals of magnetism and magnetic materials, and then more in-depth topics such as ferromagnetism and exchange, antiferromagnetism and magnetic order, micromagnetism, domains, hysteresis, and nanoscale magnetism. Students will learn engineering techniques in characterizing magnetic properties and analyzing magnetic systems. The applications of soft and hard magnetic materials in transformers, magnetometers, chokes, microwave applications, motors, generators, actuators, magnetic separation, holding magnets, etc., will be discussed. Students will also learn how and why a hard disk drive (HDD) functions. The second part of this course will focus on spintronics. Students will know how different spintronic devices work and will be able to analyze giant magnetoresistance (GMR) and tunneling magnetoresistance (TMR) devices. A special emphasis will be made on spintronic sensors and their innovative emerging applications in future spin-based data storage, power industries, health care, non-destructive testing, and others.

Pre-requisite: This course will be given at the level suitable for graduate and senior undergraduate students in electrical and electronic engineering, physics, materials science, or another relevant science or engineering discipline.

ELEC6106. From AI software to hardware: an introduction of machine learning and EDA (6 credits)

This introductory course covers two topics: basic machine learning and basic Electronic Design Automation (EDA) for Very Large Scale Integration (VLSI). The first part starts from the basic concepts and fundamentals of deep learning, including machine learning basics, deep neural networks, back-propagation, activation functions, loss functions and regularizations. Then deep learning methods are applied to a few tasks in computer vision (handwritten digits recognition) and natural language processing (name generation). Finally, successful applications and hot research directions in deep learning are showcased. The second part starts with the VLSI realization of AI and EDA design flow. It then focuses on an important component in EDA, the SPICE circuit simulation. Various SPICE simulation concepts and models (netlist, MNA, compact models) are introduced. A series of numerical methods (linear system solution, Newton's method, backward Euler and matrix exponential method) to solve the linear and nonlinear SPICE problems are then investigated, followed by an introduction of future trends in the fields.

- Introduce the basic concepts and fundamentals of machine learning.
- Introduce a popular deep learning framework and some simple tasks that can be solved with deep learning.
- Introduce possible research directions of machine learning.
- Introduce fundamental knowledge of hardware realization of AI & EDA.
- Teach basic models and algorithms for circuit simulation.
- Introduce future topics in AI hardware & EDA.

ELEC6601. Industrial marketing (6 credits)

This course covers the following topics: Business to business marketing; value chain; character of industrial marketing; marketing opportunities; marketing strategies; channel relationships; sales and sales management; marketing communications; customer programs; business ethics; and crisis management.

By means of problem-based learning, case studies, guest induction, team interaction and lectures, a student shall improve feeling of industrial marketing models; along with understanding of underlying practices and business concepts. The student shall acquire skill and proficiency through the projects and presentations. He shall be able to apply concepts, and where possible, be able to develop innovative models for potential applications.

ELEC6602. Business venture in China (6 credits)

This course covers the following topics: China economic landscape briefing; foreigner's perception on China; absolute advantages of overseas and SAR Chinese; forms of ventures; business competition; modeling negotiation; building successful ventures in China.

By means of problem-based learning, case studies, team interactions, opportunity visits and lectures, a student shall improve understanding of business channels and niches in China. The student shall acquire skill and proficiency through the projects and presentations. He shall be able to apply concepts and to develop business venture models for himself or potential entrants under the present circumstances.

ELEC6603. Success in industrial entrepreneurship (6 credits)

This course covers the following topics: Framework for entrepreneurship; identifying resources, capabilities, environments, opportunities and strategies; business plan; financing the new venture; risk balancing and staged financing; creating an organization.

By means of problem-based learning, case studies, guest induction, team interaction and lectures, a student shall improve feeling of entrepreneurship and new opportunities; along with understanding of successful models and business concepts. The student shall acquire skill and proficiency through the projects and presentations. He shall be able to apply concepts and to elaborate successful opportunities and extend them to potential applications.

ELEC6604. Neural networks, fuzzy systems and genetic algorithms (6 credits)

This course provides a general introduction to neural networks, fuzzy systems and genetic algorithms. The fundamental concepts and techniques of these three areas will be given. The course will also provide examples on the application of neural networks, fuzzy systems and genetic algorithms to a variety of engineering problems. This course will cover three important topics in the field of Applied Artificial Intelligence. By the end of this course, student should possess a firm grounding in the concepts and techniques of neural network, fuzzy system and genetic algorithm. The student should be able to apply the acquired knowledge to the development of intelligent systems or to the exploration of research problems.

ELEC7021. Dissertation (24 credits)#

This course aims at providing the in-depth training in conducting an individual design/research project at the master level.

The essence of the dissertation is for the student to embark on a research and development project on a specific topic agreed upon by the respective supervisor and endorsed by the Head. The aims of the project are not limited to technical achievement, but also reflected on self-awareness, self-management and probing the limitation of oneself.

ELEC7051. Advanced topics in communication theory and systems (6 credits)

This course covers advanced topics in communication theory and systems. The first part of the course focuses on MIMO communication that is the major breakthrough in modern communication theory and a key enabler of high-speed access in 3GPP LTE and WiFi networks. A wide range of relevant topics will be discussed including MIMO channel modeling, MIMO information theory, spatial multiplexing, space time coding, limited feedback, multiuser MIMO and multiuser diversity. In the second part of the course, we will study theories and techniques for orthogonal frequency division multiplexing (OFDM) and spread spectrum communication. The course concludes with cellular system designs where we will discuss multi-cell cooperation, dynamic resource allocation and analyze the system performance.

 # Special approval has been given by the Senate for candidates admitted to curriculum in the academic year 2016-17 to take additional discipline courses of the same credit value in lieu of the capstone experience to satisfy the curriculum requirements.

ELEC7077. Advanced topics in multimedia signals and systems (6 credits)

The course covers core and selected topics in multimedia signals and systems.

ELEC7078. Advanced topics in electrical and electronic engineering (6 credits)

To study timely advanced topics and issues of special current interest in some fields of electrical and electronic engineering.

ELEC7079. Investment and trading for engineering students (6 credits)

This course is designed for engineering students who wish to start a career in the financial industry. This course helps students to develop the basic knowledge, skill sets, and vocabulary that can communicate with the practitioners in financial industry. Students are expected to learn how to develop market view by analyzing the driving factors to forecast the movement of financial assets like equities and foreign exchange. Students will learn various financial instruments and quantitative models to support the development of investment and trading strategies. The financial instruments will be covered in this course include: options, futures and other derivatives of equities, commodities, and foreign exchanges as well as their pricing models. Investment and trading strategies that will be discussed in this course include those that commonly used in the market, for example, VWAP, TWAP, Bollinger Band, and RSI.

Mutually exclusive with: COMP7802 Introduction to financial computing

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ELEC7080. Algorithmic trading and high frequency trading (6 credits)

Program trading, which includes high frequency trading (HFT), has become important that it generated over sixty percent of trading volume at Nasdaq and NYSE. There are wide range of issues involved in program trading process, which include opportunities identification, cost/friction estimation, market impact estimation, trading strategies selection, trade scheduling, capital and liquidity management, risk management, and exit management. In this course we will review the foundations of securities trading and discuss issues that related to the market microstructure. We will review important models in the microstructure and present mathematical tools in their structural and statistical representations. We will also discuss the costs associated with trading, how these costs are measured and strategies that minimize them, including the study of models for optimal splitting of the orders across time, to reduce transaction costs and control the temporary and permanent price adjustments that result from trades. "Is that possible to use HFT in China or Hong Kong equities, options, or futures markets?" was a question that constantly been asked by practitioners and we will search for the answer together.

Pre-requisite: ELEC7079 Investment and trading for engineering students

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ELEC7081. Advanced topics in computational finance (6 credits)

This course aims to introduce finance to engineering students. Students will be introduced research that shape the frontier in finance industry.

By the end of this course, students should know what computational finance is. They should be able to realize business potentials that arise from advances in computing (the business perspective). They should also understand where in finance computational methods could be applied to (the technology perspective). They should understand what computation methods are most used in finance. They should understand the synergy between computation and finance.

Mutually exclusive with: ELEC7082 Artificial intelligence in finance

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ELEC7082. Artificial intelligence in finance (6 credits)

This course aims to introduce finance to engineering students. Students will be introduced research, in particular artificial intelligence (AI) that shape the frontier in finance industry.

By the end of this course, students should know what computational finance is. They should be able to realize business potentials that arise from advances in computing (the business perspective). They should also understand where in finance AI methods could be applied to (the technology perspective). They should understand what AI methods are most used in finance. They should understand the synergy between computation and finance.

Mutually exclusive with: ELEC7081 Advanced topics in computational finance

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ELEC7402. Advanced electric vehicle technology (6 credits)

This course aims at providing in-depth understanding of the latest technologies of electric vehicles (EVs), with emphasis on their system configurations, propulsion systems, energy systems, and development trends.

Specifically, the course covers the following topics: latest EV system concepts and designs, advanced electric machines and drives for EVs, advanced hybrid powertrains for hybrid EVs, advanced EV energy sources and energy management systems, and EV-to-grid technology.

ELEC7403. Advanced power electronics (6 credits)

The aim of this course is to provide students with an understanding of advanced subject matters in power electronics, which include (i) high-frequency switching converters; (ii) dynamics and control of switching converters; (iii) modeling of switching converters; (iv) components and devices; and (v) industrial requirements. Students enrolled in the course are expected to have prior understanding of basic power electronic principles and the operations of rectifier and phase controlled circuits, and DC/DC buck, boost, buck-boost, and Cuk converters, and knowledge of basic power devices such as power transistor, power MOSFET, and IGBT.

ELEC7404. Advanced railway engineering (6 credits)

The aim of this course is to provide students with an understanding of advanced subject matters in railway engineering, which include (i) railway operations; (ii) rolling stock; (iii) railway traction supply systems; (iv) signaling system;(v) railway infrastructures; and (vi) railway business management. Students enrolled in the module are expected to have prior understanding of basic electrical engineering and power electronic principles, the operations of AC and DC circuits, rectifier and phase controlled circuits.

ELEC7456. Advanced power system operation (6 credits)

The course discusses advanced operation methodology and control theory for modern power systems. A rigorous treatment will be adopted for practical power system operation issues, including supply demand balance, plant scheduling and unit commitment, automatic generation control and economic dispatch, load flow and fault level control, voltage and stability control, security assessment and operational planning, protection and communication system, process control system and real time control, switching operation and operational safety, emergency preparedness and black start strategy, and power system deregulation and open market's impact to system operation.

The course aims at providing students an in depth appreciation of the major issues in power system operation, thorough understanding of the concepts and principles to operate the system, and the ability to mastering the strategy and methodology to tackle these issues with clear objectives to ensure safety, security and efficiency of the entire power system.

ELEC7466. Advanced topics in power system engineering (6 credits)

This course aims at enabling detailed understanding about specific topics and issues of special current interest in power system engineering. In particular, by analysing how recent large system blackouts had occurred and the reasons leading to such incidents. The course will begin by focusing on the fundamental concepts in power system design and planning, operation and equipment choice. Special topics on issues and problem areas in network configuration, short circuit level coordination, generator design, power system stability, reactive power compensation and voltage control will be discussed.

The course also covers some advanced topics in practical issues in power system control in a modern power system control centre as well as discusses observations and different viewpoints about open power market operation in the Electricity Supply Industry.

ELEC7900. Engineering and society (6 credits)

Students who fulfill the requirements of this workshop will be able to understand his professional role in the society and how he/she should contribute to it. The course is a workshop platform for interaction among potential engineering professionals on topics related to professional conduct, social responsibility, sustainability and safety issues, technology and environment, as well as professional ethics. Legal foundation topics such as contract, intellectual property, tort, professional negligence will be introduced.

(This course will not be counted for the fulfilment of the curriculum requirements and the classification of award of the degree.)

MEBS6001. Electrical installations (6 credits)

This course covers the following topics: 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; electrical safety; distribution transformers; switchgear and fuses; motor control gears; selection of electrical equipment and conductors; lightning protection.

MEBS6019. Extra-low-voltage electrical systems in buildings (6 credits)

This course focuses on extra-low-voltage electrical systems: roles, transmission medium and network, modeling, fixed and movable system; types. Applications in building services: electrical safety; public address system, communication, cable and satellite television, conference and interpretive system, audio and visual system; service integration and automation; system monitoring. Applications in property management: fire and life-saving management equipment, electronic patrol, car park management, efficiency management, CCTV, security system, access and security control, electronic receptionist. Disturbance; electromagnetic interference and protective measures.

MSC (ENG) IN ELECTRICAL AND ELECTRONIC ENGINEERING
(applicable to students admitted to the curriculum in the academic year 2015-2016)

The Master of Science in Engineering in Electrical and Electronic Engineering curriculum has three different streams: General Stream, Communications Engineering, and Power Engineering. Each candidate is required to follow a prescribed curriculum comprising 12 modules, out of which the candidate has to pass at least 9 discipline modules selected from the three subject groups A-C. To qualify as a graduate of the Communications Engineering Stream, the candidate must pass at least 6 discipline modules in the Communications Engineering subject group. To qualify as a graduate of the Power Engineering Stream, the candidate must pass at least 6 discipline modules in the Power Engineering subject group. For General Stream, the candidate can freely choose from the three subject groups A-C. Subject to approval, candidates can select to undertake a dissertation (ELEC7021) and in which case, General Stream candidates are required to pass at least 5 discipline modules selected from the three subject groups A-C, while candidates pursuing Communications Engineering and Power Engineering Streams are required to pass at least 5 discipline modules in their respective subject groups. The candidate can select Taught Postgraduate level modules offered by other curricula in the Faculty of Engineering as electives. The Department also offers an optional module, ELEC7900 Engineering and society, in the Professional Development subject group. However, this module will not be counted for the fulfilment of the curriculum requirements and the classification of award of the degree.

Subject Groups

A. General

ELEC6008	Pattern recognition and machine learning
ELEC6027	Integrated circuit systems design
ELEC6036	High performance computer architecture
ELEC6043	Digital image processing
ELEC6049	Digital system design techniques
ELEC6063	Optoelectronics and lightwave technology
ELEC6067	Magnetic resonance imaging (MRI) technology and applications
ELEC6079	Biomedical ultrasound
ELEC6081	Biomedical signals and systems
ELEC6092	Green project management
ELEC6105	Magnetics engineering for data storage and emerging applications
ELEC6106	From AI software to hardware: an introduction of machine learning and EDA
ELEC6601	Industrial marketing
ELEC6602	Business venture in China
ELEC6603	Success in industrial entrepreneurship
ELEC6604	Neural networks, fuzzy systems and genetic algorithms
ELEC7078	Advanced topics in electrical and electronic engineering
ELEC7079	Investment and trading for engineering students
ELEC7080	Algorithmic trading and high frequency trading
ELEC7081	Advanced topics in computational finance
ELEC7082	Artificial intelligence in finance

B. Communications Engineering

ELEC6006	Communications policy and regulations
ELEC6026	Digital signal processing
ELEC6065	Data compression
ELEC6080	Telecommunications systems and management

ELEC6097 IP networks
ELEC6098 Electronic and mobile commerce
ELEC6099 Wireless communications and networking
ELEC6100 Digital communications
ELEC6103 Satellite communications
ELEC7051 Advanced topics in communication theory and systems
ELEC7077 Advanced topics in multimedia signals and systems

C. Power Engineering

ELEC6055 Power system distribution
ELEC6084 Power delivery management for metropolitan cities
ELEC6085 The role of a computerized SCADA system in power system operation
ELEC6095 Smart grid
ELEC7402 Advanced electric vehicle technology
ELEC7403 Advanced power electronics
ELEC7404 Advanced railway engineering
ELEC7456 Advanced power system operation
ELEC7466 Advanced topics in power system engineering

MEBS6001 Electrical installations
MEBS6019 Extra-low-voltage electrical systems in buildings

D. Professional Development

ELEC7900 Engineering and society
(This module will not be counted for the fulfilment of the curriculum requirements and the classification of award of the degree.)

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

All modules are assessed through examination (0%-100%) and/or coursework assessment (0%-100%).

ELEC6006. Communications policy and regulations

This module aims to provide a comprehensive understanding of Communications Policy and Regulations, and latest ICT policy and regulatory practices in the leading markets and economies. It helps students to appreciate the integration of multi-disciplinary knowledge in ICT industry.

The module also covers some advanced policy & regulatory topics in the ICT industry including convergence licensing regime, co-regulation/self-regulation, and consumer protection regulation.

ELEC6008. Pattern recognition and machine learning

This module aims at providing fundamental knowledge on the principles and techniques of pattern recognition and machine learning.

Specifically, the module covers the following topics: Bayes decision theory; parametric and non-parametric methods; linear discriminant functions; unsupervised learning and clustering; feature extraction; neural networks; context-dependent classification; case studies.

Pre-requisite: A good background in linear algebra, programming experience.

Mutually exclusive with: COMP7504 Pattern recognition and applications

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ELEC6026. Digital signal processing

This module provides an introduction to the fundamental concepts of digital signal processing (DSP) including a wide variety of topics such as discrete-time linear-time invariant systems, sampling theorem, z-transform, discrete-time/discrete Fourier transform, and digital filter design. Furthermore, the module will also discuss in detail about other advanced topics in digital signal processing such as multidimensional signals and systems, random processes and applications, and adaptive signal processing.

ELEC6027. Integrated circuit systems design

This module covers the following topics: 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.

ELEC6036. High-performance computer architecture

This module aims at providing an in-depth understanding of the principles, architectures and implementations of modern high performance computer systems which are designed and based on the proactive use of instruction-level parallelism (ILP). Specifically, the module discusses with examples and case studies to investigate the high-performance computing models; pipelining and ILP; advanced pipelining design including the scoreboard and Tomasulo algorithm; speculative execution; advanced computing models such as the cloud computing models and their possible uses in general, scientific or financial applications; and case studies like the Amazon EC2 and Google Cloud platforms.

ELEC6043. Digital image processing

This module deals with the theory, techniques and applications of digital image processing, which includes characterization, enhancement, restoration, feature extraction, representation, description and classification, advance topics in image analysis, image motion, and application case studies.

Specifically, it covers the areas of image acquisition and imaging systems, 2D continuous-time and discrete-time signals and systems, time and frequency representations, sampling and quantization issues, image filtering, convolution and enhancement, image reconstruction and restoration, image quality evaluation, image transform and compression, geometric feature extraction, image representation and description, image analysis, motion and case studies.

Prerequisite: Exposure to signals and systems at the level of ELEC3241

ELEC6049. Digital system design techniques

This module aims to provide a structured approach to digital system design. Fundamental to this is an understanding of the underlying technologies for modern day digital systems and the methods of analysis. Systematic design methodology and computer aids are crucial to tackling systems of increasing complexity. Selected design issues (such as faults, testability) will also be presented where appropriate.

The module begins with an overview of digital technologies, their evolution and the implication on design realization. Students are updated on fundamental theories and essential building blocks to prepare them for higher level systems design. A structured approach is used to quickly guide students from basic combinational logic to more complex digital systems such as RTL or programmable processors. Design tradeoffs and optimizations are emphasized as an integral part of the design process.

The module also covers hardware description language (Verilog) as a high level design tool. Where resources allow, students will have the chance of gaining experience on the use of Verilog.

ELEC6055. Power system distribution

This module provides a platform for electrical engineers to strengthen their technical expertise in power distribution from design to application at an advanced level. State-of-the-art technologies for distributing electricity safely, reliably, cost-effectively and environmentally to customers are covered. Major distribution network configurations together with the associated protection systems adopted by reputable power companies worldwide for ensuring supply reliability and operational flexibility are also included. Strategies for enhancing supply reliability and power quality, as well as meter revenue loss prevention techniques are also examined.

Whilst the module is most valuable to practising electrical engineers, it also furnishes engineers of other trades with background knowledge for coordinating their work with counterparts engaged in power supply industry as well as building services engineering field.

ELEC6063. Optoelectronics and lightwave technology

The aim of this module is to broaden the knowledge in the hardware of in optical communication systems from optoelectronic devices to integrated optical network.

Optical communication system has almost become a “must” technique in data/signal transmission (i.e. fiber to home). Students will have the ability to address the issues:
(i) what optoelectronic components are required in the system and the operation principles and device physics,
(ii) the issues that have been be considered to build a optical network by using the optoelectronic components
(iii) to evaluate the performance of the optical network to meet the target/budget (technical) and to improve the performance (using advanced technology).
All the issues will be discussed in this module.

ELEC6065. Data compression

This module provides an introduction to the state-of-the-art compression techniques for typical media including files, digital images, videos and audios. Specifically, the module will discuss in detail about the coding and quantization techniques commonly used for images, videos and audios. Finally, the module will cover basic concept and terminologies of common image, video and audio standards.

ELEC6067. Magnetic resonance imaging (MRI) technology and applications

With advances in engineering and computing, an extraordinary body of imaging technologies and applications has developed over the last 25 years. Among the various in vivo imaging modalities available or under development today, magnetic resonance imaging (MRI) is one of the most versatile and valuable one.

This module is basically divided into two parts, covering a variety of MR related topics in detail. The first part of the module will focus on the fundamental principles and hardware of MRI while the second part will be on the advanced MRI applications.

At the end of the module, students should gain a thorough understanding in the principles of MRI and MR systems. They will also learn the latest state-of-the-art applications of MRI in research and clinical practices.

Pre-requisite: Introductory module in physics or electromagnetism

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ELEC6079. Biomedical ultrasound

This is a first module on the technical aspect of biomedical ultrasound, and it is designed for senior-level MedE undergraduates. We will cover the physical principles behind ultrasound, its medical imaging modes, and its therapeutic usages. There will be opportunity for students to learn how to operate an ultrasound imaging system.

There are two major aims for this module. First, it aims to provide students with a top-down technical overview on ultrasound and its biomedical applications. Second, it aims to equip students with hands-on experience in operating an ultrasound scanner.

ELEC6080. Telecommunications systems and management

This module aims to provide a comprehensive understanding of major telecommunications systems (i.e. fixed, mobile, wireless, etc.), and contemporary management practices (e.g. strategy planning, product development, marketing, customer service, etc.) in telecommunications systems. It helps students to appreciate the integration of multi-disciplinary knowledge in telecommunications sectors.

The module also covers some more advanced topics in the ICT industry including next generation networks (e.g. NGA such as FTTx, HSPA+/4G/LTE, HetNet, etc.), convergence development (i.e. device, network, service, sector, etc.), multiple-play and OTT services.

ELEC6081. Biomedical signals and systems

This module aims at introducing the origins, characteristics, analyses and clinical applications of the most common and important biomedical signals, including electrocardiography (ECG), electromyography (EMG), electroencephalography (EEG), etc. Application-oriented biomedical signal processing and pattern recognition techniques will be introduced, ranging from the very basic methods (e.g., Fourier transform) to advanced methods (e.g., independent component analysis). With the aid of in-depth case studies, the module offers practical guidance on how to choose appropriate processing methods for solving specific problems of biomedical research. Recent developments and the state-of-the-art of biomedical signals and systems, such as brain-computer interface, will also be discussed.

ELEC6084. Power delivery management for metropolitan cities

This module provides a platform for electrical engineers to strengthen their technical expertise in power delivery in metropolitan cities from design to application at an advanced level. State-of-the-art technologies for safe, reliable, cost-effective and environmentally-friendly power delivery to customers are covered. Major power delivery network designs together with the associated protection systems adopted by reputable power companies worldwide for ensuring supply reliability and operational effectiveness are also included. Strategies for loss prevention management, enhancement of supply reliability and power quality are also examined.

Whilst the module is most valuable to practising electrical engineers, it also furnishes engineers of other related disciplines with necessary engineering knowledge for coordinating their work with counterparts engaged in power supply industry as well as building services engineering field.

ELEC6085. The role of a computerized SCADA system in power system operation

This module aims at introducing the methodologies for designing a Computerized Supervisory Control and Data Acquisition (SCADA) system for power system control and automation. The module will start with an introduction to basic power system operations for ensuring secure & effective power generation, transmission & distribution and how SCADA systems can help. Then the basic functions of a SCADA system will be analyzed and described. This is followed by automatic functions which can be implemented for power systems to enhance performance, reliability and economy. After that the software structure of various subsystems in a SCADA system will be explained. Finally, techniques for enhancing SCADA system performance and reliability will be introduced.

ELEC6092. Green project management

This module aims at introducing Green Project Management. By giving a brief account on the environmental issues, the module will begin by explaining the scope and value of green projects. It will illustrate the importance of clarity of mission and goals of green projects; and how these could be done by means of audit and feasibility study. It will also describe how green project planning and control can be implemented with proper system tools. The basic theory regarding contract management: project strategy, contract documents, tendering procedure and contingency shall be introduced. It will also give examples of site implementation: partnership collaboration; project quality assurance; safety management; environmental issues and risk management. The module shall be concluded by detailing project quality assurance; safety management.

ELEC6095. Smart grid

This module aims at providing fundamental knowledge of various smart grid technologies. The challenges of the future electric power grid, renewable energy integration, energy utilization, energy storage system, automation and communication technologies in smart grid will be covered. Topics on the smart devices/applicances and energy saving control are included.

Mutually exclusive with: ELEC6096, MEBS6018

ELEC6097. IP Networks

This module aims at enabling detailed understanding about how the Internet works. The module will begin by focusing on the fundamental concepts in the Internet architecture. This is followed by detailed examinations of the key protocols at application layer, transport layer, network layer, and link layer.

Mutually exclusive with: ELEC6007, ELEC7144

ELEC6098. Electronic and mobile commerce

This module aims at introducing both technical, commercial and managerial knowledge on electronic commerce and mobile. The module will start with an introduction to the Business-to-Consumer (B2C) Model; Business-to- Business (B2B) model, followed by an overviews of different enabling technologies for electronic commerce and mobile commerce such as the location base technology, RFID, GPS, mobile network, electronic payment, server-side and channel security, Near Field Communication, QR Code, augmented reality and other latest technologies deploying in the industry. By the end of the module, the research trend and the way forward of the industry will be discussed.

Mutually exclusive with: ELEC6078, ELEC6086

ELEC6099. Wireless communications and networking

5G refers to the fifth generation wireless technologies for digital cellular networks that began wide deployment in 2019. This course aims at introducing the core principles and technologies for 5G communications and networking. The first half focuses on basic concepts and techniques including radio propagation, digital modulation, Orthogonal Frequency Division Multiplexing (OFDM), Multiple-Input-Multiple-Output (MIMO) Communication. The second half provides a comprehensive introduction to 5G covering physical layer (PHY) technologies, millimetre wave (mmWave) communications, network virtualization and slicing, provides an introduction to different types of networks including cellular networks, satellite communication networks, narrow-band Internet-of-Things (NB-IoT).

Mutually exclusive with: ELEC6040, ELEC6071, ELEC6087

ELEC6100. Digital Communications

This module aims at enabling the fundamental understanding of the digital communication systems. After an overview on basic probability and random processes, the module will cover the modulation and demodulation. Then, performance analyses under additive white Gaussian noise channel and fading channel are examined. This is followed by topics on spatial diversity and channel equalization.

Mutually exclusive with: ELEC6014 and ELEC6045

ELEC6103. Satellite communications

This module is an introduction to satellite communications taught at a level appropriate for postgraduates reading for the MSc curriculum in electrical and electronic engineering. It is aimed at providing a general understanding and an overview on satellite communications, with emphasis on the recent applications and developments

The following topics will be covered: basics of satellite communications system: orbital aspects, launching, link budgets, modulation, error control coding, and multiple access, earth station, very small aperture terminals (VSATs), global positioning system (GPS) and satellites for mobile communication.

At the end of the module, students should have gained a general understanding on satellite communications systems and also recent applications and developments of satellite communications.

ELEC6105. Magnetics engineering for data storage and emerging applications

Magnetics supports a gigantic commercial market valued at over US$100 billion per year worldwide. A wide range of industries utilizing magnetics-based technologies require highly skilled magnetics engineers. This course is designed to provide knowledge and expertise in the field of magnetic engineering, which is vital to a number of industrial sectors including the data storage, computers, health & medical, advanced materials, non-destructive testing, transport & aerospace, energy generation and distribution, and power industries. The Nobel Prize in Physics 2007 was awarded to a new magnetics engineering regime – spintronics. It combines magnetism (electron spin) and microelectronics (charge transport) whereby spin of the electrons adds a new dimension to the practice of electronics. This new discovery opens up innovative designs and products for data storage and other emerging applications.

This course will start with the fundamentals of magnetism and magnetic materials, and then more in-depth topics such as ferromagnetism and exchange, antiferromagnetism and magnetic order, micromagnetism, domains, hysteresis, and nanoscale magnetism. Students will learn engineering techniques in characterizing magnetic properties and analyzing magnetic systems. The applications of soft and hard magnetic materials in transformers, magnetometers, chokes, microwave applications, motors, generators, actuators, magnetic separation, holding magnets, etc., will be discussed. Students will also learn how and why a hard disk drive (HDD) functions. The second part of this course will focus on spintronics. Students will know how different spintronic devices work and will be able to analyze giant magnetoresistance (GMR) and tunneling magnetoresistance (TMR) devices. A special emphasis will be made on spintronic sensors and their innovative emerging applications in future spin-based data storage, power industries, health care, non-destructive testing, and others.

Pre-requisite: This course will be given at the level suitable for graduate and senior undergraduate students in electrical and electronic engineering, physics, materials science, or another relevant science or engineering discipline.

ELEC6106. From AI software to hardware: an introduction of machine learning and EDA

This introductory course covers two topics: basic machine learning and basic Electronic Design Automation (EDA) for Very Large Scale Integration (VLSI). The first part starts from the basic concepts and fundamentals of deep learning, including machine learning basics, deep neural networks, back-propagation, activation functions, loss functions and regularizations. Then deep learning methods are applied to a few tasks in computer vision (handwritten digits recognition) and natural language processing (name generation). Finally, successful applications and hot research directions in deep learning are showcased. The second part starts with the VLSI realization of AI and EDA design flow. It then focuses on an important component in EDA, the SPICE circuit simulation. Various SPICE simulation concepts and models (netlist, MNA, compact models) are introduced. A series of numerical methods (linear system solution, Newton's method, backward Euler and matrix exponential method) to solve the linear and nonlinear SPICE problems are then investigated, followed by an introduction of future trends in the fields.

- Introduce the basic concepts and fundamentals of machine learning.

- Introduce a popular deep learning framework and some simple tasks that can be solved with deep learning.
- Introduce possible research directions of machine learning.
- Introduce fundamental knowledge of hardware realization of AI & EDA.
- Teach basic models and algorithms for circuit simulation.
- Introduce future topics in AI hardware & EDA.

ELEC6601. Industrial marketing

This module covers the following topics: Business to business marketing; value chain; character of industrial marketing; marketing opportunities; marketing strategies; channel relationships; sales and sales management; marketing communications; customer programs; business ethics; and crisis management.

By means of problem-based learning, case studies, guest induction, team interaction and lectures, a student shall improve feeling of industrial marketing models; along with understanding of underlying practices and business concepts. The student shall acquire skill and proficiency through the projects and presentations. He shall be able to apply concepts, and where possible, be able to develop innovative models for potential applications.

ELEC6602. Business venture in China

This module covers the following topics: China economic landscape briefing; foreigner's perception on China; absolute advantages of overseas and SAR Chinese; forms of ventures; business competition; modeling negotiation; building successful ventures in China.

By means of problem-based learning, case studies, team interactions, opportunity visits and lectures, a student shall improve understanding of business channels and niches in China. The student shall acquire skill and proficiency through the projects and presentations. He shall be able to apply concepts and to develop business venture models for himself or potential entrants under the present circumstances.

ELEC6603. Success in industrial entrepreneurship

This module covers the following topics: Framework for entrepreneurship; identifying resources, capabilities, environments, opportunities and strategies; business plan; financing the new venture; risk balancing and staged financing; creating an organization.

By means of problem-based learning, case studies, guest induction, team interaction and lectures, a student shall improve feeling of entrepreneurship and new opportunities; along with understanding of successful models and business concepts. The student shall acquire skill and proficiency through the projects and presentations. He shall be able to apply concepts and to elaborate successful opportunities and extend them to potential applications.

ELEC6604. Neural networks, fuzzy systems and genetic algorithms

This module provides a general introduction to neural networks, fuzzy systems and genetic algorithms. The fundamental concepts and techniques of these three areas will be given. The module will also provide examples on the application of neural networks, fuzzy systems and genetic algorithms to a

variety of engineering problems. This module will cover three important topics in the field of Applied Artificial Intelligence. By the end of this module, student should possess a firm grounding in the concepts and techniques of neural network, fuzzy system and genetic algorithm. The student should be able to apply the acquired knowledge to the development of intelligent systems or to the exploration of research problems.

ELEC7021. Dissertation (4 modules)

ELEC7051. Advanced topics in communication theory and systems

This module covers advanced topics in communication theory and systems. The first part of the module focuses on MIMO communication that is the major breakthrough in modern communication theory and a key enabler of high-speed access in 3GPP LTE and WiFi networks. A wide range of relevant topics will be discussed including MIMO channel modeling, MIMO information theory, spatial multiplexing, space time coding, limited feedback, multiuser MIMO and multiuser diversity. In the second part of the module, we will study theories and techniques for orthogonal frequency division multiplexing (OFDM) and spread spectrum communication. The module concludes with cellular system designs where we will discuss multi-cell cooperation, dynamic resource allocation and analyze the system performance.

ELEC7077. Advanced topics in multimedia signals and systems

The module covers core and selected topics in multimedia signals and systems.

ELEC7078. Advanced topics in electrical and electronic engineering

To study timely advanced topics and issues of special current interest in some fields of electrical and electronic engineering.

ELEC7079. Investment and trading for engineering students

This module is designed for engineering students who wish to start a career in the financial industry. This module helps students to develop the basic knowledge, skill sets, and vocabulary that can communicate with the practitioners in financial industry. Students are expected to learn how to develop market view by analyzing the driving factors to forecast the movement of financial assets like equities and foreign exchange. Students will learn various financial instruments and quantitative models to support the development of investment and trading strategies. The financial instruments will be covered in this module include: options, futures and other derivatives of equities, commodities, and foreign exchanges as well as their pricing models. Investment and trading strategies that will be discussed in this module include those that commonly used in the market, for example, VWAP, TWAP, Bollinger Band, and RSI.

Mutually exclusive with: COMP7802 Introduction to financial computing

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ELEC7080. Algorithmic trading and high frequency trading

Program trading, which includes high frequency trading (HFT), has become important that it generated over sixty percent of trading volume at Nasdaq and NYSE. There are wide range of issues

involved in program trading process, which include opportunities identification, cost/friction estimation, market impact estimation, trading strategies selection, trade scheduling, capital and liquidity management, risk management, and exit management. In this module we will review the foundations of securities trading and discuss issues that related to the market microstructure. We will review important models in the microstructure and present mathematical tools in their structural and statistical representations. We will also discuss the costs associated with trading, how these costs are measured and strategies that minimize them, including the study of models for optimal splitting of the orders across time, to reduce transaction costs and control the temporary and permanent price adjustments that result from trades. "Is that possible to use HFT in China or Hong Kong equities, options, or futures markets?" was a question that constantly been asked by practitioners and we will search for the answer together.

Pre-requisite: ELEC7079 Investment and trading for engineering students

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ELEC7081. Advanced topics in computational finance

This module aims to introduce finance to engineering students. Students will be introduced research that shape the frontier in finance industry.

By the end of this module, students should know what computational finance is. They should be able to realize business potentials that arise from advances in computing (the business perspective). They should also understand where in finance computational methods could be applied to (the technology perspective). They should understand what computation methods are most used in finance. They should understand the synergy between computation and finance.

Mutually exclusive with: ELEC7082 Artificial intelligence in finance

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ELEC7082. Artificial intelligence in finance

This module aims to introduce finance to engineering students. Students will be introduced research, in particular artificial intelligence (AI) that shape the frontier in finance industry.

By the end of this module, students should know what computational finance is. They should be able to realize business potentials that arise from advances in computing (the business perspective). They should also understand where in finance AI methods could be applied to (the technology perspective). They should understand what AI methods are most used in finance. They should understand the synergy between computation and finance.

Mutually exclusive with: ELEC7081 Advanced topics in computational finance

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ELEC7402. Advanced electric vehicle technology

This module aims at providing in-depth understanding of the latest technologies of electric vehicles (EVs), with emphasis on their system configurations, propulsion systems, energy systems, and development trends.

Specifically, the module covers the following topics: latest EV system concepts and designs, advanced

electric machines and drives for EVs, advanced hybrid powertrains for hybrid EVs, advanced EV energy sources and energy management systems, and EV-to-grid technology.

ELEC7403. Advanced power electronics

The aim of this module is to provide students with an understanding of advanced subject matters in power electronics, which include (i) high-frequency switching converters; (ii) dynamics and control of switching converters; (iii) modeling of switching converters; (iv) components and devices; and (v) industrial requirements. Students enrolled in the module are expected to have prior understanding of basic power electronic principles and the operations of rectifier and phase controlled circuits, and DC/DC buck, boost, buck-boost, and Cuk converters, and knowledge of basic power devices such as power transistor, power MOSFET, and IGBT.

ELEC7404. Advanced railway engineering

The aim of this course is to provide students with an understanding of advanced subject matters in railway engineering, which include (i) railway operations; (ii) rolling stock; (iii) railway traction supply systems; (iv) signaling system;(v) railway infrastructures; and (vi) railway business management. Students enrolled in the module are expected to have prior understanding of basic electrical engineering and power electronic principles, the operations of AC and DC circuits, rectifier and phase controlled circuits.

ELEC7456. Advanced power system operation

The module discusses advanced operation methodology and control theory for modern power systems. A rigorous treatment will be adopted for practical power system operation issues, including supply demand balance, plant scheduling and unit commitment, automatic generation control and economic dispatch, load flow and fault level control, voltage and stability control, security assessment and operational planning, protection and communication system, process control system and real time control, switching operation and operational safety, emergency preparedness and black start strategy, and power system deregulation and open market's impact to system operation.

The module aims at providing students an in depth appreciation of the major issues in power system operation, thorough understanding of the concepts and principles to operate the system, and the ability to mastering the strategy and methodology to tackle these issues with clear objectives to ensure safety, security and efficiency of the entire power system.

ELEC7466. Advanced topics in power system engineering

This module aims at enabling detailed understanding about specific topics and issues of special current interest in power system engineering. In particular, by analysing how recent large system blackouts had occurred and the reasons leading to such incidents. The module will begin by focusing on the fundamental concepts in power system design and planning, operation and equipment choice. Special topics on issues and problem areas in network configuration, short circuit level coordination, generator design, power system stability, reactive power compensation and voltage control will be discussed.

The module also covers some advanced topics in practical issues in power system control in a modern power system control centre as well as discusses observations and different viewpoints about open power

market operation in the Electricity Supply Industry.

ELEC7900. Engineering and society

Students who fulfill the requirements of this workshop will be able to understand his professional role in the society and how he/she should contribute to it. The module is a workshop platform for interaction among potential engineering professionals on topics related to professional conduct, social responsibility, sustainability and safety issues, technology and environment, as well as professional ethics. Legal foundation topics such as contract, intellectual property, tort, professional negligence will be introduced.

(This module will not be counted for the fulfilment of the curriculum requirements and the classification of award of the degree.)

MEBS6001. Electrical installations

This module covers the following topics: 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; electrical safety; distribution transformers; switchgear and fuses; motor control gears; selection of electrical equipment and conductors; lightning protection.

MEBS6019. Extra-low-voltage electrical systems in buildings

This module focuses on extra-low-voltage electrical systems: roles, transmission medium and network, modeling, fixed and movable system; types. Applications in building services: electrical safety; public address system, communication, cable and satellite television, conference and interpretive system, audio and visual system; service integration and automation; system monitoring. Applications in property management: fire and life-saving management equipment, electronic patrol, car park management, efficiency management, CCTV, security system, access and security control, electronic receptionist. Disturbance; electromagnetic interference and protective measures.

SYLLABUS FOR THE DEGREE OF MASTER OF SCIENCE IN ENGINEERING IN ENERGY ENGINEERING
MSC(ENG)(EnergyE)

(This syllabus is applicable to students admitted to the curriculum in the academic year 2019-2020 and thereafter)

Definition and Terminology

Discipline course – any course on a list of courses in the discipline of curriculum which a candidate must pass at least a certain number of credits as specified in the Regulations.

Elective course – any course offered by the Departments of the Faculty of Engineering for the fulfilment of the curriculum requirements of the degree of MSc(Eng) in Energy Engineering that are not classified as discipline courses.

Capstone Experience – a 12-credit project or a 24-credit dissertation which is a compulsory and integral part of the curriculum.

Curriculum Structure

Candidates are required to complete 72 credits of courses as set out below, normally over one academic year of full-time study or two academic years of part-time study:

	Enrolment Mode of 10 courses + Project	**Enrolment Mode of 8 courses + Dissertation**
Course Category	**No. of Credits**	**No. of Credits**
Discipline Courses	Not less than 36	Note more than 30
Elective Courses	Not more than 24	Not more than 18
Capstone Experience	12	24
Total	72	72

Candidates shall select courses in accordance with the regulations of the degree. Candidates are required to follow a prescribed curriculum comprising either a 24-credit dissertation and another 8 courses, including at least 5 discipline courses from the List of Discipline Courses (including at least 2 fundamental courses) and no more than 3 courses offered by other taught postgraduate curricula in the Faculty of Engineering as electives ;or a 12-credit project and 10 courses, including at least 6 discipline courses from the List of Discipline Courses (including at least 2 fundamental courses) and no more than 4 courses offered by other taught postgraduate curricula in the Faculty of Engineering as electives. All course selection will be subject to approval by the Course Coordinators.

List of Discipline Courses for MSc(Eng) in Energy Engineering

Fundamental courses (select at least two out of three):
EMEE6002. Sustainability and climate change (fundamental)
EMEE6005. Renewable energy technology I: Fundamental (fundamental)
EMEE6010. Electricity quality and energy efficiency (fundamental)

ELEC7402. Advanced electric vehicle technology
ELEC7404 Advanced railway engineering
EMEE6003. Nuclear energy
EMEE6004. Energy conservation and management
EMEE6006. Renewable energy technology II: Advanced
EMEE6007. Energy and carbon audit
EMEE6008. Green project management
EMEE6009. Green facilities management

EMEE6011. Energy saving lighting
MEBS6016. Energy performance of buildings
MECH7011. Applied thermodynamics and power plant technology

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

All courses are assessed through examination and/or coursework assessment.

ELEC7402. Advanced electric vehicle technology (6 credits)

This course aims at providing in-depth understanding of the latest technologies of electric vehicles (EVs), with emphasis on their system configurations, propulsion systems, energy systems, and development trends.

Specifically, the course covers the following topics: latest EV system concepts and designs, advanced electric machines and drives for EVs, advanced hybrid powertrains for hybrid EVs, advanced EV energy sources and energy management systems, and EV-to-grid technology.

ELEC7404. Advanced railway engineering (6 credits)

The aim of this course is to provide students with an understanding of advanced subject matters in railway engineering, which include (i) railway operations; (ii) rolling stock; (iii) railway traction supply systems; (iv) signaling system;(v) railway infrastructures; and (vi) railway business management. Students enrolled in the module are expected to have prior understanding of basic electrical engineering and power electronic principles, the operations of AC and DC circuits, rectifier and phase controlled circuits.

EMEE6002. Sustainability and climate change (fundamental) **(6 credits)**

This course aims at introducing the cause and consequence of climate change. A few technical solutions for solving the climate change problems, such as solar energy, nuclear energy, smart grid, electric vehicle, green ICT and energy efficiency audit, will be introduced.

In addition, other non-technical solution such as: carbon trade, Clean Development Mechanism, Kyoto protocol and carbon audit will be discussed. The course provides both theoretical background and practical knowledge of the causes and solutions of the problem. The sustainability and issues in Hong Kong and China, such as air, water, solid waste and electronic waste pollutions, will be discussed.

Mutually exclusive with ELEC7407

EMEE6003. Nuclear energy (6 credits)

Students in this course will acquire the fundamental knowledge on nuclear energy and nuclear power system, ranging from the fundamental principles of nuclear physics, nuclear power system design and operation, waste disposal, to risk assessment and safety management. In addition to technical knowledge, nuclear governance and policy governing the safe and effective operation of nuclear power plants will be covered. Students will be equipped with the necessary knowledge benefitting their careers development in the nuclear power industry.

Mutually exclusive with ELEC6104

EMEE6004. Energy conservation and management (6 credits)

This course aims to: (1) understand the technological, social, economic and environmental factors related to the use of fossil fuels and renewable energy; (2) understand the major energy consumers in buildings, transportation and industrial processes; and (3) identify effective energy conservation and conduct energy audits and management systems.

Topics include: energy sources and environmental impact; energy in buildings; energy-efficient industrial processes; waste heat recovery; energy storage; energy auditing; energy strategies and management.

Students who have taken and passed MECH 6033 will not be allowed to take EMEE6004.

EMEE6005. Renewable energy technology I: Fundamental (fundamental) **(6 credits)**

This course focuses mainly on different renewable energy technologies including hydro power, wind power, bioenergy, solar thermal, solar PV, energy storage, and energy usage. The specific course objectives are: (1) to have a deep understanding of the important role played by renewable energy in our energy supply; and (2) to grasp the fundamentals of different energy resources; (3) to understand energy storage and its important role in solving intermittency and other issues; and (4) to understand how to use energy more efficiently with solid state lighting and other energy saving technologies.

Topics include: renewable energy in a big picture; hydro power; winder power; solar thermal; solar PV; bioenergy; energy storage: intermittancy and other issues; energy usage: solid state lighting.

Students who have taken and passed MECH 6042 will not be allowed to take EMEE6005.

EMEE6006. Renewable energy technology II: Advanced (6 credits)

This course is on the working principles of advanced energy conversion devices including solar cells, fuel cells, batteries, photoelectrochemical (PEC) water splitting cells, and thermoelectric cells. Also covered are the energy carriers in different materials and the connection between different energy conversion devices. The specific course objectives are as: (1) to have a deep understanding of the energy carriers in different materials and their important roles in energy conversion; (2) to grasp the working principles of different energy conversion devices; (3) to be able to tell the differences and similarities between different energy conversion devices; and (4) to be able to design more efficient energy conversion devices.

Topics include: introduction: energy carriers in energy conversion cells; solar cells; fuel cells; electrochemical cells; photoelectrochemical (PEC) water splitting; thermoelectric cells.

Students who have taken and passed MECH 6043 will not be allowed to take EMEE6006.

EMEE6007. Energy and carbon audit (6 credits)

This course aims to: (1) provide students with the fundamental principles, skills and guidelines needed to carry out effective energy and carbon audits for the commercial and industrial sectors; (2) enable students to identify energy saving and carbon reduction measures and perform quantitative analysis to predict the energy savings and carbon reduction, environmental and economic benefits; and (3) enable students to verify the performance of implemented energy saving and carbon reduction measures.

Topics include: greenhouse gas emission; global warming; energy benchmarking; electrical distribution system; power quality and power factor; energy efficient lighting; motor; HVAC energy audit; refrigeration cycle; passive cooling; heating appliances; energy consumptions in compressors and pumps; energy saving measurements; local and international guidelines in energy and carbon audit; carbon footprint calculator.

Students who have taken and passed MECH 6044 will not be allowed to take EMEE6007.

EMEE6008. Green project management (6 credits)

This course aims at introducing Green Project Management. By giving a brief account on the environmental issues, the course will begin by explaining the scope and value of green projects. It will illustrate the importance of clarity of mission and goals of green projects; and how these could be done by means of audit and feasibility study. It will also describe how green project planning and control can be implemented with proper system tools. The basic theory regarding contract management: project strategy, contract documents, tendering procedure and contingency shall be introduced. It will also give examples of site implementation: partnership collaboration; project quality assurance; safety management; environmental issues and risk management. The course shall be concluded by detailing project quality assurance; safety management.

Mutually exclusive with ELEC6092

EMEE6009. Green facilities management (6 credits)

The course shall enhance classmates' engineering mindset in designing and performing maintenance activities and management in green facilities and related plants. The mindset shall cover analysis and synthesis of plant operations individually and also as entities in a system. The classmates shall utilize quantitative approach, qualitative approach and management rules to tackle problems. The manager so trained shall perform professionalism in achieving optimal benefits in green assets in a safe and effective manner.

This course covers the following topics: Value Chains with Green Facilities; Types of Green Facilities; Current Trend and Development; Operational Stresses in Facilities; Reliability and Availability, Maintainability and Sustainability; Preventive and Corrective Maintenance Management Tools: Quantitative Tools and Qualitative Tools; and Asset Management.

Mutually exclusive with ELEC6093

EMEE6010. Electricity quality and energy efficiency (fundamental) (6 credits)

The course shall enhance students' engineering concepts in designing the selecting activities in electrical services and related plants. The mindset shall cover analysis and synthesis of plant performance quality, plant invulnerability, and energy efficiency. The classmates shall utilize quantitative approach, qualitative approach and management rules to settle issues. The students shall perform professionalism in achieving optimal benefits.

EMEE6011. Energy saving lighting (6 credits)

This course begins with a review of the importance of lighting, the different forms of electrical lighting and their energy consumptions, as well as their environmental impacts. This is followed by an introduction to the properties and measurement of light. The physics and technologies of different forms of electrical lighting, namely incandescent, electric discharge and semiconductor lighting will be studied in details. This includes the mechanism of light generation, the methods of driving the light sources, the efficiencies of each lighting technologies, the optical properties of light emission amongst other topics. The merits and disadvantages of each technology are highlighted and critically compared. At the end of the course, the candidate should be able to make a learned choice on energy-efficient light sources.

Mutually exclusive with ELEC6090

EMEE7001. Dissertation (24 credits)

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

EMEE7002. Project (12 credits)

The aim of the project is to provide an opportunity for the student to apply what they have learnt from classes to conduct an individual design project in a specific topic related to their profession to be agreed upon by the respective supervisor and endorsed by the Head. The

objectives of the project are not limited to technical achievement, but also reflected on self-awareness, self-management and probing the limitation of oneself. Another objective is to make the learning experience inclusive, enjoyable, and career beneficial.

Upon supervision by the teacher, the student will develop skills through individually carrying out the Project Requirement and Design, Implementation and Evaluation, Report and Presentation on the designated project. Students are encouraged to explore and make suggestions on the direction of the project over the project development process. The project supervisor shall provide assistance and aids along each phase in the project development process with the student.

Each project student is generally required to have meetings and discussions with his/her supervisors on a regular basis. Mid-term Review will be held with both the supervisors and the 2nd examiner in order to review the student's progress. The final assessment will be based on Project Report, Presentation, and Demonstration.

MEBS6016. Energy performance of buildings (6 credits)

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 building; economic and financial analyses.

MECH7011. Applied thermodynamics and power plant technology (6 credits)

This course is focused on understanding the operating principles of power plants for the generation of electric power. The course objectives are to: (1) provide students with the working principles of various types of power plants, including fossil fuels, nuclear fuels and renewable energy; and (2) enable students to understand the thermodynamic principles, emission controls, environmental impact, cycle analysis, component design, plant operation and control technologies of power plant.

Topics include: sources of energy; thermodynamic properties of states; types of power plants; portable combustion engines; Brayton cycle; gas turbines; Rankine cycle; steam power plants; nuclear power plant; solar farm; wind turbines; thermoelectric energy.

Students who have taken and passed MECH6023 will not be allowed to take MECH7011.

SYLLABUS FOR THE DEGREE OF MASTER OF SCIENCE IN ENGINEERING IN ENERGY ENGINEERING
MSC(ENG)(EnergyE)

(This syllabus is applicable to students admitted to the curriculum in the academic year 2016-2017, 2017-18 and 2018-19)

Definition and Terminology

Discipline course – any course on a list of courses in the discipline of curriculum which a candidate must pass at least a certain number of credits as specified in the Regulations.

Elective course – any course offered by the Departments of the Faculty of Engineering for the fulfilment of the curriculum requirements of the degree of MSc(Eng) in Energy Engineering that are not classified as discipline courses.

Capstone Experience# – a 24-credit dissertation which is a compulsory and integral part of the curriculum.

Curriculum Structure

Candidates are required to complete 72 credits of courses as set out below, normally over one academic year of full-time study or two academic years of part-time study:

Course Category	No. of Credits
Discipline Courses	Not less than 30
Elective Courses	Not more than 18
Capstone Experience#	24
Total	72

Candidates shall select courses in accordance with the regulations of the degree. Candidates are required to follow a prescribed curriculum comprising a 24-credit dissertation and another 8 courses, including at least 5 discipline courses from the List of Discipline Courses (including at least 2 fundamental courses). They may select no more than 3 courses offered by other taught postgraduate curricula in the Faculty of Engineering as electives. All course selection will be subject to approval by the Course Coordinators.

 # Special approval has been given by the Senate for candidates admitted to curriculum in the academic year 2016-17 to take additional discipline courses of the same credit value in lieu of the capstone experience to satisfy the curriculum requirements.

List of Discipline Courses for MSc(Eng) in Energy Engineering

Fundamental courses (select at least two out of three):
EMEE6002. Sustainability and climate change (fundamental)
EMEE6005. Renewable energy technology I: Fundamental (fundamental)
EMEE6010. Electricity quality and energy efficiency (fundamental)

ELEC7402. Advanced electric vehicle technology
ELEC7404. Advanced railway engineering
EMEE6003. Nuclear energy
EMEE6004. Energy conservation and management
EMEE6006. Renewable energy technology II: Advanced
EMEE6007. Energy and carbon audit
EMEE6008. Green project management
EMEE6009. Green facilities management

EMEE6011. Energy saving lighting
MEBS6016. Energy performance of buildings
MECH7011. Applied thermodynamics and power plant technology

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

All courses are assessed through examination and/or coursework assessment.

ELEC7402. Advanced electric vehicle technology (6 credits)

This course aims at providing in-depth understanding of the latest technologies of electric vehicles (EVs), with emphasis on their system configurations, propulsion systems, energy systems, and development trends.

Specifically, the course covers the following topics: latest EV system concepts and designs, advanced electric machines and drives for EVs, advanced hybrid powertrains for hybrid EVs, advanced EV energy sources and energy management systems, and EV-to-grid technology.

ELEC7404. Advanced railway engineering (6 credits)

The aim of this course is to provide students with an understanding of advanced subject matters in railway engineering, which include (i) railway operations; (ii) rolling stock; (iii) railway traction supply systems; (iv) signaling system;(v) railway infrastructures; and (vi) railway business management. Students enrolled in the module are expected to have prior understanding of basic electrical engineering and power electronic principles, the operations of AC and DC circuits, rectifier and phase controlled circuits.

EMEE6002. Sustainability and climate change (fundamental) **(6 credits)**

This course aims at introducing the cause and consequence of climate change. A few technical solutions for solving the climate change problems, such as solar energy, nuclear energy, smart grid, electric vehicle, green ICT and energy efficiency audit, will be introduced. In addition, other non-technical solution such as: carbon trade, Clean Development Mechanism, Kyoto protocol and carbon audit will be discussed. The course provides both theoretical background and practical knowledge of the causes and solutions of the problem.

The sustainability and issues in Hong Kong and China, such as air, water, solid waste and electronic waste pollutions, will be discussed.

Mutually exclusive with ELEC7407

EMEE6003. Nuclear energy (6 credits)

Students in this course will acquire the fundamental knowledge on nuclear energy and nuclear power system, ranging from the fundamental principles of nuclear physics, nuclear power system design and operation, waste disposal, to risk assessment and safety management. In addition to technical knowledge, nuclear governance and policy governing the safe and effective operation of nuclear power plants will be covered. Students will be equipped with the necessary knowledge benefitting their careers development in the nuclear power industry.

Mutually exclusive with ELEC6104

EMEE6004. Energy conservation and management (6 credits)

This course aims to: (1) understand the technological, social, economic and environmental factors related to the use of fossil fuels and renewable energy; (2) understand the major energy consumers in buildings, transportation and industrial processes; and (3) identify effective energy conservation and conduct energy audits and management systems.

Topics include: energy sources and environmental impact; energy in buildings; energy-efficient industrial processes; waste heat recovery; energy storage; energy auditing; energy strategies and management.

Students who have taken and passed MECH 6033 will not be allowed to take EMEE6004.

EMEE6005. Renewable energy technology I: Fundamental (fundamental) **(6 credits)**

This course focuses mainly on different renewable energy technologies including hydro power, wind power, bioenergy, solar thermal, solar PV, energy storage, and energy usage. The specific course objectives are: (1) to have a deep understanding of the important role played by renewable energy in our energy supply; and (2) to grasp the fundamentals of different energy resources; (3) to understand energy storage and its important role in solving intermittency and other issues; and (4) to understand how to use energy more efficiently with solid state lighting and other energy saving technologies.

Topics include: renewable energy in a big picture; hydro power; winder power; solar thermal; solar PV; bioenergy; energy storage: intermittancy and other issues; energy usage: solid state lighting.

Students who have taken and passed MECH 6042 will not be allowed to take EMEE6005.

EMEE6006. Renewable energy technology II: Advanced (6 credits)

This course is on the working principles of advanced energy conversion devices including solar cells, fuel cells, batteries, photoelectrochemical (PEC) water splitting cells, and

thermoelectric cells. Also covered are the energy carriers in different materials and the connection between different energy conversion devices. The specific course objectives are as: (1) to have a deep understanding of the energy carriers in different materials and their important roles in energy conversion; (2) to grasp the working principles of different energy conversion devices; (3) to be able to tell the differences and similarities between different energy conversion devices; and (4) to be able to design more efficient energy conversion devices.

Topics include: introduction: energy carriers in energy conversion cells; solar cells; fuel cells; electrochemical cells; photoelectrochemical (PEC) water splitting; thermoelectric cells.

Students who have taken and passed MECH 6043 will not be allowed to take EMEE6006.

EMEE6007. Energy and carbon audit (6 credits)

This course aims to: (1) provide students with the fundamental principles, skills and guidelines needed to carry out effective energy and carbon audits for the commercial and industrial sectors; (2) enable students to identify energy saving and carbon reduction measures and perform quantitative analysis to predict the energy savings and carbon reduction, environmental and economic benefits; and (3) enable students to verify the performance of implemented energy saving and carbon reduction measures.

Topics include: greenhouse gas emission; global warming; energy benchmarking; electrical distribution system; power quality and power factor; energy efficient lighting; motor; HVAC energy audit; refrigeration cycle; passive cooling; heating appliances; energy consumptions in compressors and pumps; energy saving measurements; local and international guidelines in energy and carbon audit; carbon footprint calculator.

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EMEE6008. Green project management (6 credits)

This course aims at introducing Green Project Management. By giving a brief account on the environmental issues, the course will begin by explaining the scope and value of green projects. It will illustrate the importance of clarity of mission and goals of green projects; and how these could be done by means of audit and feasibility study. It will also describe how green project planning and control can be implemented with proper system tools. The basic theory regarding contract management: project strategy, contract documents, tendering procedure and contingency shall be introduced. It will also give examples of site implementation: partnership collaboration; project quality assurance; safety management; environmental issues and risk management. The course shall be concluded by detailing project quality assurance; safety management.

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Mutually exclusive with ELEC6093

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Mutually exclusive with ELEC6090

EMEE7001. Dissertation (24 credits)#

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

MEBS6016. Energy performance of buildings (6 credits)

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 building; economic and financial analyses.

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Topics include: sources of energy; thermodynamic properties of states; types of power plants; portable combustion engines; Brayton cycle; gas turbines; Rankine cycle; steam power plants; nuclear power plant; solar farm; wind turbines; thermoelectric energy.

Students who have taken and passed MECH6023 will not be allowed to take MECH7011.
