Bachelor of Engineering in Mechanical and Automation Engineering (334 New Curriculum)

Unless otherwise specified, all are 3-unit term courses. Please check CUSIS for the most up-to-date information.)

Faculty Package

ENGG1100 Introduction to Engineering Design

This is a hands-on project-based course which introduces the basic engineering concepts, experimental skills and design methodology needed for the design and construction of a hardware based system. Students will work in small groups on a practical project in which they will apply the design methodology introduced to them in lectures in a design project. The project work will involve defining milestones, identifying the constraints and requirements, defining the requirement specifications of the design, making and evaluating different possible designs by carrying out experiments to obtain data for refining the design, prototyping of the final design and testing of the system built in the project.

Enrollment Requirement: Not for students who have taken ESTR1000.

ENGG1110 Problem Solving By Programming

This is a software project course. Students will learn fundamental programming concepts. They will choose project(s) from the engineering disciplines. Through the project(s), students will acquire the skills to define problems and specifications, to perform modelling and simulation, to develop system prototypes, to carry out verification, validation, and performance analysis.

Enrollment Requirement: Not for students who have taken CSCI1030 or 1110 or 1120 or 1130 or 1510 or 1520 or 1530 or 1540 or ESTR1002 or 1100 or 1102.

ENGG2600 Technology, Society and Engineering Practice *(applicable to students admitted in 2012-13 & 2013-14)*

Impact of technology on society; introduction to engineering as a profession (different engineering fields, professional societies and registration, soft skills for working in a team); engineering design and innovation; introduction to intellectual property (copyright, trademarks, registered design and patents); engineering project management; product safety; professional ethics; liability and responsibility; workplace safety; environmental impact and market requirements; case studies and experience sharing from industry; global energy policies and standards; industrial and professional workshops or seminars as required by the Major programme.

Enrollment Requirement: Not for students who have taken ESTR2008.

ENGG2601 Technology, Society and Engineering Practice *(2 units)*
Impact of technology on society; introduction to engineering as a profession (different engineering fields, professional societies and registration, soft skills for working in a team); engineering design and innovation; introduction to intellectual property (copyright, trademarks, registered design and patents); engineering project management; product safety; professional ethics; liability and responsibility; workplace safety; environmental impact and market requirements; case studies and experience sharing from industry; global energy policies and standards.

ENGG2602 Engineering Practicum *(1 unit)*
Industrial and professional workshops or seminars as required by the Major programme.
(Students majoring in ELEG or BMEG are required to consult their department regarding arrangement of the industrial/professional workshop before they register for the course.)

Foundation Science Courses

CHEM1070 Principles of Modern Chemistry *(applicable to students admitted in 2015-16 and before)*
This is a foundation course to give a comprehensive overview of 21st Century chemistry for science students. The topics include the electronic structures of atoms and molecules, their roles in chemical bonding and the properties of matters; acid/base reactions; oxidation/reduction reactions; the laws of thermodynamics and their applications in chemical equilibrium; and an introduction to organic chemistry.

The basic principles are applied in the discussion of global issues such as the pollution of air and water; the greenhouse effect; the ozone hole; the urgency and the difficulty in finding sustainable energy sources; the use of green materials for manufacturing consumer products; and the benefits and abuses of drugs.

CHEM1280 Introduction to Organic Chemistry and Biomolecules *(applicable to students admitted in 2012-13 & 2013-14)*
This course provides an overview of the important roles of organic functional groups in forming biomolecules. Under themes of common interests and practical importance, this course will provide students with an understanding of the relevant basic principles of organic chemistry to explore the formation, structures and chemical properties of biomolecules. Selected fundamental concepts in chemical bonding and stereochemistry relevant to the understanding of biomolecules will be highlighted.

CHEM1380 Basic Chemistry for Engineers
Elements and Compounds, Atomic Structure, Theories of Chemical Bonding, Periodic Properties, Gases, liquids, solids, and solutions, Chemical Equilibrium, Acids and bases, Oxidation and Reduction, Thermochemistry, Thermodynamics, Electrochemistry, Chemical Kinetics, Materials, Properties of Polymers, Nuclear Chemistry, Metallurgy.

Enrollment Requirement: For New Curriculum Students.

ENGG1310 Engineering Physics: Electromagnetics, Optics and Modern Physics

This is an introductory calculus-based engineering physics course covering topics in electromagnetics, optics and modern physics. Topics in electromagnetics include: electric and magnetic properties, Coulomb's law, Gauss' law, electromagnetic energy and forces, Biot-Savart law, electromagnetic fields and Maxwell's equations, propagation of plane electromagnetic waves. Topics in optics include: optical interference, interferometers, optical diffraction. Topics in modern physics include: wave-particle duality, momentum and energy of photons and electrons, electronic states and energy bands, electrical conduction in metals and semiconductors. Contents will be supplemented by discussions on applications relevant to engineering.
Enrollment Requirement: Not for students who have taken ENGG2520, ESTR2006 or ESTR1003.

ENGG2520 Engineering Physics II *(applicable to students admitted in 2014-15 or before)*

This is an introductory calculus-based engineering physics course covering topics in electromagnetism and modern physics. Topics in electricity and magnetism include: Coulomb's law, electric field, electric flux, Gauss' law, electric potential, capacitance, electrostatic energy and forces, Biot-Savart Law, magnetic dipole, magnetic field, inductance, magnetic energy and forces, electromagnetic fields and Maxwell's equations, propagation of plane electromagnetic waves. Topics in modern physics include: Wave-particle duality, momentum and energy of photons and electrons, electronic states and energy bands, electrical conduction in metals and semiconductors. Contents will be supplemented by discussions on applications relevant to engineering.

Enrollment Requirement: Not for students who have taken ESTR2006.

LSCI1001 Basic Concepts in Biological Sciences

This foundation course is designed for students who have not taken science courses with a biology component at the senior secondary school level. It presents our current understandings on cells and molecules of life, genetics and evolution, organisms and environment, and health and diseases. Those students who have successfully completed this course will have a solid foundation for studying more advanced courses in life sciences.

Add Consent: Department Consent Required.
Enrollment Requirement: Not for students who have taken LSCI1002 or 1003.

LSCI1003 Life Sciences for Engineers

This course gives engineering students exposure to some of the basic and essential concepts in biology and biotechnology. Topics include cell structure and energy metabolism, DNA structure and replication, protein structure and function, genetic engineering, stem cell and tissue regeneration, neural biology, cardiovascular system, muscle and skeletal system of animals, microbes and microbial biotechnology. The overall aim of this course is to introduce students with the fundamental ideas and concepts in life sciences especially those with relevance to engineering studies.

Enrollment Requirement: Not for students who have taken LSCI1001.

PHYS1003 General Physics for Engineers

This non-calculus-based course covers some essential concepts in mechanics, heat, electricity and magnetism. It is designed for engineering students without having studied HKDSE physics or Combined Science with a physics component to get an overview on what physics is about. Selected topics include: Newton's laws of motion, Archimedes' principle, fluid flow, temperature and heat, laws of thermodynamics, electric field and potential, current and circuits, and electromagnetic waves. This course cannot be taken by students with HKDSE Physics or Combined Science with a physics component.

Enrollment Requirement: For New Curriculum Students.

PHYS1110 Engineering Physics: Mechanics and Thermodynamics

This is an introductory calculus-based engineering physics course covering topics in mechanics and thermodynamics. Topics include: Use of vectors in mechanics, force and motion, free-body diagrams, work and energy, potential energy and conservation of energy, momentum and impulse, torque, essential ideas in rotation, equilibrium, gravitation, ideal fluids, oscillations, waves and sound, elementary concepts of thermodynamics and heat transfer mechanisms. Contents will be supplemented by discussions on applications relevant to engineering. The course is suitable for Engineering students with HKDSE physics or Combined Science with a physics component, or with permission of instructor.

Foundation Mathematics Courses

ENGG1410 Linear Algebra and Vector Calculus for Engineers

Linear algebra: matrices, matrix addition, matrix multiplication, inverses, special matrices; vector spaces, basis and dimension, linear independence, rank, determinants; linear transformations, projection, orthogonality, systems of linear equations, Gaussian elimination, LU decomposition; eigenvalues and eigenvectors. Vector calculus: 3-D vector space and algebra; vector differential calculus, gradient, divergence, curl; vector integral calculus, Green's theorem, Gauss's theorem, Stoke's theorem.

Enrollment Requirement: Not for students who have taken ESTR1004. Pre-requisite: MATH1510.

ENGG2420 Complex Analysis and Differential Equations for Engineers

Complex analysis: analytic functions and Cauchy Riemann; complex integration, Cauchy principal value; elementary complex valued functions: exponential functions, Euler's formula, trigonometric and hyperbolic functions, logarithm and general powers; power series, Taylor series and convergence tests.

ODE: classification of differential equations; 1st order ordinary differential equations; 2nd order ordinary differential equations. Partial differential equations.

Enrollment Requirement: Not for students who have taken ENGG2460 or ESTR2000 or ESTR2010.

ENGG2430 Probability and Statistics for Engineers
Fundamental probability concepts: probability and events; expectation, variance, moments, moment generating functions; single variate distributions. Multivariate probability: conditional probability, joint probability; Bayes' Theorem; conditional expectation, covariance; multivariate distributions, functions of random variables. Central limit theorems, law of large number. Statistics: estimation, sample size and applications.

Enrollment Requirement: Not for students who have taken ESTR2002, ESTR2005 and ENGG2450.

MATH1510 Calculus for Engineers
This course is designed for engineering students who need to acquire skills in calculus as a crash introduction to the mathematics used in engineering. The course emphasizes on the technique of computation without theoretical discussion. Students are expected to have mathematics background equivalent to HKDSE with Extended Module I or II.

Major Required Courses

ELEG2202 Fundamental of Electric Circuits
Basic circuit laws and theorems, mesh and nodal analysis, superposition and source transformation; analysis of operational amplifier circuits and their applications; concept of phasor and impedance; AC analysis, power factor correction, maximum power transfer; introduction to transient analysis; three-phase circuits; basic magnetic principles and electrical equivalent circuits; inductors and transformers; basic electromechanical principles.

Enrollment Requirement: Not for students who have taken ELEG1110.

MAEG2020 Engineering Mechanics
Equations of equilibrium. Friction. Moments of inertia. Kinematics and kinetics of particles. Energy and momentum methods of particles. Kinematics and dynamics of rigid bodies. Energy and momentum methods for rigid bodies.

Enrollment Requirement: Not for students who have taken ESTR2400.

MAEG2030 Thermodynamics
Fundamental concepts. Pure substance. Work and heat. First and second laws of thermodynamics. Entropy. Elementary power and refrigeration cycles. Applications to air conditioning and internal combustion engines.

Enrollment Requirement: Not for students who have taken ESTR2402.

MAEG3010 Mechanics of Materials
Linear elasticity. Stress and strain. Stress-strain relations. Loading and deformation. Statically indeterminate problems. Torsion. Shear forces and bending moments. Stresses in beams. Deflections of beams.

MAEG3020 Manufacturing Technology
Overview of manufacturing engineering, engineering materials, metal forming processes, machining processes, plastic injection molding processes, and assembly. Hands-on experiments/projects.

Enrollment Requirement: Not for students who have taken ESTR3404.

MAEG3030 Fluid Mechanics *(breadth elective for students admitted in 2015-16 & before)*
Nature of fluids. Fluid statics. Integral and differential equations of fluid flows. Conservation of mass, momentum and energy. Dimensional analysis. Internal flow. External flow. Applications of fluid mechanics in engineering systems.

MAEG3050 Introduction to Control Systems
Mathematical modelling and linear approximation of engineering systems. Laplace transform. Transfer function and block diagram representation. Characteristics of feedback systems. Performance specifications. Routh-Hurwitz stability criterion. Root locus design. Frequency response design. Nyquist criterion. Utilization of computer-aided analysis and design software.

Enrollment Requirement: Not for students who have taken ESTR3406.

MAEG4998 Final Year Project I
The course is designed to provide students with an opportunity to carry out, under the supervision of an academic staff, an independent project with research elements in engineering.

MAEG4999 Final Year Project II
The course is designed to provide students with an opportunity to carry out, under the supervision of an academic staff, an independent project with research elements in engineering.

Enrollment Requirement: Pre-requisite: MAEG4998.

Major Elective Courses

Breadth Electives

CSCI1020 Hands-on Introduction to C++ *(1 unit)*

This course aims to provide an intensive hands-on introduction to the C++ programming language. Topics include the basic C++ language syntax, variable declaration, basic operators, program flow and control, defining and using functions, file and operating system interface. Specific key features of the C++ programming language such as object-oriented methodology, class templates, encapsulation, inheritance, polymorphism, etc. will be highlighted.

Enrollment Requirement: Not for students who have taken CSCI1120 or 1520 or 1540 or ESTR1100.

CSCI1040 Hands-on Introduction to Python *(1 unit)*

This course aims to provide an intensive hands-on introduction to the Python scripting language. Topics include the basic Python language syntax, variable declaration, basic operators, programme flow and control, defining and using functions, file and operating system interface. Specific key features of the Python scripting language such as object-oriented support, high level dynamic data types, embedding within applications etc. will be highlighted.

CSCI1050 Hands-on Introduction to MATLAB *(1 unit)*

This course aims to provide an intensive hands-on introduction to MATLAB programming. Topics include using the MATLAB interactive environment, variables, operators, expressions, control structures, arrays and matrix operations, defining and using functions, plotting graphs, using Simulink, etc.

CSCI2100 Data Structures

The concept of abstract data types and the advantages of data abstraction are introduced. Various commonly used abstract data types including vector, list, stack, queue, tree, and set and their implementations using different data structures (array, pointer based structures, linked list, 2-3 tree, B-tree, etc.) will be discussed. Sample applications such as searching, sorting, etc., will also be used to illustrate the use of data abstraction in computer programming. Analysis of the performance of searching and sorting algorithms. Application of data structure principles.

Enrollment Requirement: Not for students who have taken ESTR2102 or CSCI2520; Pre-requisite: CSCI1110 or 1120 or 1130 or 1510 or 1520 or 1530 or 1540 or ENGG1110 or ESTR1100 or ESTR1102 or ESTR1002 or its equivalent. For senior-year entrants, the prerequisite will be waived.

CSCI2120 Introduction to Software Engineering (2 units)

This course aims to introduce students to software engineering concepts. Software life cycles and processes: requirements analysis and specifications; design techniques, functional design, object oriented design; implementation methodology, software testing and maintenance; application of CASE tools; documentation. Software Engineering laboratory: a series of exercises to practise the principles of software engineering.

Enrollment Requirement: Not for students who have taken CSCI3100 or IERG3080 or ENGG3820. Prerequisite: CSCI1110 or 1120 or 1130 or 1510 or 1520 or 1530 or 1540 or ESTR1100 or 1102 or

(MATH2210 and 2220) or PHYS2351 or its equivalent.

CSCI2800 Numerical Computation

This course aims at introducing the computational techniques on numerical methods. Course contents include computational error analysis; algorithms for roots finding; solutions of linear and non-linear equations, and their sensitivity to computational errors; constrained and unconstrained optimization; curve fitting; applications examples.

Enrollment Requirement: Prerequisite: CSCI1110 or 1120 or 1130 or 1510 or 1520 or 1530 or 1540 ESTR1100 or 1102.

CSCI3170 Introduction to Database Systems

Concepts and principles of database management systems. Subjects include: basic concepts, system structures, data models, database languages (SQL in particular), relational database normalization, file systems, indexing, query processing, concurrency control and recovery schemes.

Enrollment Requirement: Prerequisite: CSCI2100 or 2520 or ESTR2102. For 2nd-year entrants, the prerequisite will be waived.

DSME1030 Economics for Business Studies I

This course is a general introduction to the theory of price in a market economy. Topics include basic economic concepts, the theory of demand, production and cost, the operation of firms in competitive, oligopolistic and monopolistic markets, costs and benefits of government intervention in market economy, and introduction to game theory and informational economics. Analytical approach is used whenever appropriate. Applications on practical business problems are emphasized.

Enrollment Requirement: Not for students who have taken ECON2011 or ECON3011.

[or *SEEM2440 Engineering Economics*]

Principles of engineering economy. Value and cost; cash flows. Economic analysis of alternatives, technological, social and human factors. Models involving allocation and scheduling of resources. Analytical techniques for evaluating industrial projects. Relationship between economics of technical choice and industrial productivity. Basic financial accounting concepts; accounting cycle; financial statements.

Enrollment Requirement: Not for students who have taken SEEM2510 or ESTR2500.

EEEN2020/ENER2020 Renewable Energy Technologies *(ENER-courses are recoded to EEEN-courses for students admitted in 2016-17 and thereafter)*

The effort of securing more sustainable, reliable, and affordable energy supplies is among the most challenges faced in this century. This course focuses on scientific and engineering fundamentals of renewable energy resources and conversion technologies. The subject-specific lectures will be provided in more depth to cover these topics: global energy sources, thermodynamics for renewable energy, solar energy, wind energy, hydro power, bioenergy, geothermal, fuel cell, and design, modeling and analysis of energy systems.

Enrollment Requirement for EEEN2020: Not for students who have taken ENER2020 or MAEG3090.

Enrollment Requirement for ENER2020: Not for students who have taken MAEG3090.

EEEN3030/ENER3030 Engineering Materials *(ENER-courses are recoded to EEEN-courses for students admitted in 2016-17 and thereafter)*
Fundamentals of materials including atomic bonding; crystal structures, defects; mechanical properties of materials, phase diagram; overview of metals, alloys, ceramics, polymers, semiconductors and composites; electrical, optical, magnetic, and thermal properties of materials; materials selection and design considerations for engineering technologies. Applications of materials to energy engineering, mechanical engineering, medical engineering, and others will be discussed.

Enrollment Requirement for EEEN3030: Not for students who have taken ENER3030 or ESTR3402.

Enrollment Requirement for ENER3030: Not for students who have taken ESTR3402.

ELEG2401 Introduction to Embedded Systems
Introduction to microcomputer systems and to the concept of memory. Fundamentals of micro-controller unit, instructions and assembly programming. Input/Output. Interrupt. Timer and counter. Serial communication. Interfacing. Application to step motor. C programming for MCU.

Enrollment Requirement: Not for students who have taken ELEG3230; Prerequisite: ELEG2201 or with the consent of the instructor.

ELEG3101 Medical Instrumentation and Sensors
Fundamental concepts of the design of instrumentation and sensor. Electrode theory. Wireless electrodes. Transducers. Biosensors. Applications of microprocessor system for measurements. Micro-controller based measurement systems. The origins and measurements of bioelectric, ultrasonic and bioacoustic signals. Application examples: electro-bioimpedance measurements, cochlear implant devices, functional electric stimulators, drug delivery systems, etc. Electrical safety and hazard.

Enrollment Requirement: Not for students who have taken ELEG3240 or BMEG3101 or ESTR3210.

ENER2010 Energy Technologies and the Environment *(applicable to students admitted in 2015-16 & before)*
In a modern society, our living standard strongly correlates with our energy consumption rate. The rapid rise of energy use after WWII has caused the degradation of our environment as well as adverse health effects in human populations. Furthermore, the steady rise of recent global average temperature and its correlation with the atmospheric CO2 concentration is particularly alarming. This course provides an overview of the present energy industry and their environmental impact. Fossil fuel is our main energy source today. Therefore, coal, petroleum and natural gas are emphasized. Their formation, exploration, reserve distribution, production, transport, refinement, final consumption, waste disposal and the carbon cycle are studied. The mechanical structure, configuration and efficiency of various fossil-fueled power plants and automobile engines are

described. The life cycle assessment method is used to evaluate their requirement on water withdraw and consumption, carbon footprint and their relationship to global warming. Nuclear power plants provide approximately 20% of our electricity without producing greenhouse gases. Their operating principle, the biological effects of ionizing radiations, the radioactive waste problem, the nuclear weapon proliferation concerns, the risk of large scale accidents like Chernobyl (1986) and Fukushima (2011), and different nuclear policies adopted by various governments are discussed. These lead to the need of renewable energy sources for sustainable developments. The current status of solar, wind, biomass, hydropower, and geothermal energies are briefly presented as an introduction to the next course on renewable energy technologies.

Note: Calculus is NOT a prerequisite. However, high school level of physics, chemistry and mathematics are required.

[or ENGG1500 Introduction to Energy and Environment (applicable to students admitted in 2012-13)]
Introduction to the power generation and energy resources: including fossil fuels, nuclear power and renewable energy (such as hydro power, solar power, wind power, biomass and biofuels, and geothermal power). Energy supply, utilization and sustainability. Impact on the environment.

ENGG1820 Engineering Internship *(1 unit)*
The objective of the course is to enable students to have a basic understanding of the practical aspects of the engineering profession. Prior to the enrolment of this course, students must have completed not less than 8 weeks of full-time internship approved by the Faculty of Engineering. To be qualified for award of the subject credit, the student must submit a report, within the semester of enrolment, summarizing what he or she has done and learnt during the internship, together with a testimonial from the corresponding employer. Pass or fail of the course will be determined by the professor-in-charge, based on the report and the testimonial submitted.

Student may look for internship opportunities at the Placement and Internship Program (PIP) website administered by Centre for Innovation and Technology of the Faculty, or from any other sources available to him or her. Students are recommended to seek professor-in-charge's comment on internship undertaken before enrolling in the course.

Work-Study, the 12-month internship program organized by the Faculty, is a valid internship satisfying the requirements of ENGG1820.

Advisory: For year 2 or above Engineering Majors students. (new curriculum)

ENGG2020 Digital Logic and Systems
Digital concepts; number systems; operations and codes; logic gates; Boolean algebra and logic simplification; combinational logic; functions of combinational logic; flip-flops and related devices; counters; finite state machines; programmable logic devices - programming and sequential logic applications; memory and storage; integrated circuit technologies.

Enrollment Requirement: Not for students who have taken ELEG2120 or ESTR2104.

ENGG5404 Micromachining and Microelectromechanical Systems
Broad overview of microfabrication and microelectromechanical systems. Introduction to basic micromaching techniques such as photolithography, isotropic and anisotropic wet etching, dry etching, physical and chemical vapor deposition, electroplating, metrology, statistical design of experiments, MEMS release etching, stiction, and MEMS device testing. Review of MEMS microsensors, microactuators and microstructures. Topics include accelerometers, pressure sensor, optical switches, cantilever beams, thin-film stress test structures and bulk micromaching test structures. Fundamentals of central dogma of molecular biology, cell and tissue biology. Principles of transduction and measurements of molecules, cells and tissues.

Enrollment Requirement: For students in MSc BMEG and MAEG; or MPhil-PhD programmes under Faculty of Engineering; or For undergraduate students in BMEG or MAEG; Not for students who have taken BMEG5120, MAEG5050 or MAEG5750

[Equivalent to MAEG5050 MEMS and Nano-Robotics]
Introduction to MEMS/NEMS devices. Micro/Nano fabrication techniques. MEMS/NEMS design methodology. Experimental methods for Micro/Nano devices. Applications for MEMS/NEMS. Dominant physical phenomena in the Micro/Nano worlds. Micro and Nano scale robotics and assembly. (Equivalent to ACE5090)

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering or MPhil-PhD Mechanical and Automation Engineering or MSc Mechanical and Automation Engineering or UG Mechanical and Automation Engineering; Not for students who have taken MAEG5750

MAEG1010 Introduction to Robot Design
Introduction to robots. Sensors and sensing circuits. Electrical actuators and control systems. Motion mechanisms. Robot design and rapid prototyping. Examples of industrial applications. Design and construction of a functional robot.

MAEG2010 Computer-Aided Drafting *(2 units)*
Introduction to concepts and skills needed to sketch and create 2D drawings and 3-D models. Introduction to CAD systems. A series of projects for students to learn and practice using various CAD packages for modelling, engineering drawing, animation and analysis.

MAEG3030 Fluid Mechanics *(Breadth elective for students admitted in 2015-16 and before)*
Nature of fluids. Fluid statics. Integral and differential equations of fluid flows. Conservation of mass, momentum and energy. Dimensional analysis. Internal flow. External flow. Applications of fluid mechanics in engineering systems.

MAEG3040 Mechanical Design
Engineering design process. Machine design methodology. Kinematics analysis. Load analysis. Materials and manufacture. Component design. Design synthesis and optimization. Design for reliability. Human factors in design.

MAEG3060 Introduction to Robotics
Robot classification and specification. Coordinate frames and homogeneous transformations. Denavit-Hartenberg notation. Forward and inverse kinematics. Differential motion. Jacobians and statics. Singularity. Actuators, sensors, and end effectors.Trajectory generation. Introduction to robot motion planning.

Enrollment Requirement: Not for students who have taken ESTR3408.

MAEG3070 Fundamentals of Computer-Aided Design
Elements of interactive graphics in CAD/CAM. Mathematical bases and manipulation of curves and surfaces: parametric cubic curve, Bezier and NURBS curve, ruled surface, sweep surface, Coon's bilinear surface, Hermite surface, Bezier and NURBS surfaces. Introduction to geometric and solid modeling: constructive solid geometry, boundary representation. Visualization for engineering simulation. Applications in design and manufacturing.

MAEG3080 Fundamentals of Machine Intelligence
Data structures, sorting, and searching. Knowledge representation: state space; logical statements; rules; connectionism. Discrete problem solving by state space search. Deduction by resolution in predicate logic. Inference by ruled-based systems. Mappings by networks. Principles of learning. Application examples.

MAEG3920 Engineering Design and Applications
The course includes a project for students to practice the following topics: engineering design process, innovation and design basics, CAD and CAE tools and applications, prototyping (mechanical workshop), prototyping (electronics workshop), quality and inspection.

MAEG5050 MEMS and Nano-Robotics
Introduction to MEMS/NEMS devices. Micro/Nano fabrication techniques. MEMS/NEMS design methodology. Experimental methods for Micro/Nano devices. Applications for MEMS/NEMS. Dominant physical phenomena in the Micro/Nano worlds. Micro and Nano scale robotics and assembly. (Equivalent to ACE5090)

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering or MPhil-PhD Mechanical and Automation Engineering or MSc Mechanical and Automation Engineering or UG Mechanical and Automation Engineering; Not for students who have taken MAEG5750

[Equivalent to ENGG5404 Micromachining and Microelectromechanical Systems]
Broad overview of microfabrication and microelectromechanical systems. Introduction to basic micromaching techniques such as photolithography, isotropic and anisotropic wet etching, dry etching, physical and chemical vapor deposition, electroplating, metrology, statistical design of experiments, MEMS release etching, stiction, and MEMS device testing. Review of MEMS microsensors, microactuators and microstructures. Topics include accelerometers, pressure sensor, optical switches, cantilever beams, thin-film stress test structures and bulk micromaching test structures. Fundamentals of central dogma of molecular biology, cell and tissue biology. Principles of transduction and measurements of molecules, cells and tissues.

Enrollment Requirement: For students in MSc BMEG and MAEG; or MPhil-PhD programmes under Faculty of Engineering; or For undergraduate students in BMEG or MAEG; Not for students who have taken BMEG5120, MAEG5050 or MAEG5750

MAEG5080 Smart Materials and Structures

Overview of smart materials technology. Characteristics of smart materials such as piezoelectric materials, magnetorheological fluids, and shape memory alloys. Smart actuators and sensors. Structural modelling and design. Dynamics and control for smart structures. Integrated system analysis. Applications in biomedical devices, precision machinery, transportation, and buildings. (Equivalent to ACE5120)

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering or MPhil-PhD Mechanical and Automation Engineering or MSc Mechanical and Automation Engineering or UG Mechanical and Automation Engineering; Not for students who have taken MAEG5760

MAEG5120 Nanomaterials and Nanotechnology: Fundamentals and Applications

This course provides both fundamental knowledge of nanomaterials and nanotechnology and advanced topics related to applications. These topics cover basic principles, which include the scaling law, the surface science for nanomaterials, observation and characterization tools for nanomaterials, the nanofabrication techniques, building blocks for nanodevices and systems, etc. In the second half of this course, advanced topics on applying nanomaterials and nanotechnology for applications in mechanical engineering, energy engineering and biomedical engineering will be covered.

Enrollment Requirement: For students in MSc Mechanical and Automation Engineering; or For students in MPhil-PhD Mechanical and Automation Engineering; or For undergraduate students in Mechanical and Automation Engineering; Pre-requisite: ENER3030 or ESTR3402

MGNT1010 Introduction to Business

This course aims at providing an introduction to the general concepts of business. It describes the economic, political, social and cultural environment in which managers and organizations function. Major topics include: the framework of business, the basic business functions, managerial functions and other selected business considerations.

Enrollment Requirement: Not for Integrated BBA Majors or other BAF Majors or students who have taken UGEC2750.

MGNT4090 Technology and Innovation Management

Today's uncertain, ambiguous and fast changing business environment means that managers must be able to find creative solutions to problems and implement them effectively. This course is concerned with developing insights and skills related to that vital task. It will examine the process of developing technology and innovation in organizations and introduce students to methods for developing creativity at the individual, group and organizational levels. It will examine the process of putting innovative ideas into practice. Finally, it will conside rthe organizational context - in terms of structure, culture, and management style - which can either inhibit or facilitate innovation and new technology.

Enrollment Requirement: Prerequisite: HTMG1010 or MGNT1020.

SEEM2440 Engineering Economics

Principles of engineering economy. Value and cost; cash flows. Economic analysis of alternatives, technological, social and human factors. Models involving allocation and scheduling of resources. Analytical techniques for evaluating industrial projects. Relationship between economics of technical choice and industrial productivity. Basic financial accounting concepts; accounting cycle; financial statements.

Enrollment Requirement: Not for students who have taken SEEM2510 or ESTR2500.

[or *DSME1030 Economics for Business Studies I*]
This course is a general introduction to the theory of price in a market economy. Topics include basic economic concepts, the theory of demand, production and cost, the operation of firms in competitive, oligopolistic and monopolistic markets, costs and benefits of government intervention in market economy, and introduction to game theory and informational economics. Analytical approach is used whenever appropriate. Applications on practical business problems are emphasized.
Enrollment Requirement: Not for students who have taken ECON2011 or ECON3011.

SEEM3450 Engineering Innovation and Entrepreneurship

Factors that drive continuous creative product innovation. Study of processes of creating, assessing and pursuing product opportunities. Evaluation of new product ideas and risk assessment of commercialization. Product development strategies in industrial marketing. Understanding the behaviour of buyer. Formulation and implementation of innovative marketing strategy and business plan.

Enrollment Requirement: Not for students who have taken ESTR3502.

SEEM3490 Information Systems Management

In-depth discussion of the challenges, techniques and technologies associated with the management of IT in a competitive environment. The linkage of IT to business strategy and business process re-engineering. Type of information systems: MIS, DSS, TPS. Development process. Information system planning. Systems project management and control. IT acquisition, budgeting and deployment. Performance evaluation and auditing. Operations management. Privacy and security.

SEEM3500 Quality Control and Management

Quality planning, control and improvement. Sampling theory. Statistical quality control theory applied to production operations. Specification and control charts for monitoring production systems. Quality engineering - the Taguchi Method. Quality control issues of manufacturing and service industry. Case studies of quality control problems in industry. Use of computer aids. Introduction to ISO 9000.

Enrollment Requirement: Prerequisites: SEEM2430 or ENGG2430 or ENGG2450 or ESTR2002 or ESTR2005 or with the approval of the course instructor.

Depth Electives

EEEN4010/ENER4010 Kinetic Energy Harvesting Devices and Systems *(ENER-courses are recoded to EEEN-courses for students admitted in 2016-17 and thereafter)*
Principles of energy harvesting from wind, wave, water flow and vibration. Component and system design. Control and power conditioning circuits. Modeling and performance analysis and optimization. Applications. Hands-on project.

Enrollment Requirement for EEEN4010: Not for students who have taken ENER4010 or ESTR4400. Prerequisite: MAEG3030 or with the consent of the course instructor.

Enrollment Requirement for ENER4010: Not for students who have taken ESTR4400. Prerequisite: MAEG3030 or with the consent of the course instructor.

EEEN4020/ENER4020 Solar Energy and Photovoltaic Technology *(ENER-courses are recoded to EEEN-courses for students admitted in 2016-17 and thereafter)*
Introduction to solar energy technologies; semiconductors for photovoltaics; working principle and performance evaluation of photovoltaic cells (PVs); photovoltaic technologies (crystalline PVs, thin-film PVs, and organic and nanostructure based PVs); solar panel system design; cost aspects, market development and environmental impact of photovoltaic industry.

Enrollment Requirement for EEEN4020: Not for students who have taken ENER4020 or ESTR4402. Prerequisite: 1. ELEG2202 and EEEN2020/ENER2020 or 2. ELEG2202 and ELEG3201/ESTR3200

Enrollment Requirement for ENER4020: Not for students who have taken ESTR4402. Prerequisite: 1. ELEG2202 and EEEN2020/ENER2020 or 2. ELEG2202 and ELEG3201/ESTR3200

EEEN4030/ENER4030 Nuclear Energy and Risk Assessment *(ENER-courses are recoded to EEEN-courses for students admitted in 2016-17 and thereafter)*
Nuclear physics - elementary quantum theory; nuclear forces; shell structure of the nucleus; alpha, beta, and gamma radioactive decays; nuclear reactions; fission and fusion. Nuclear power plant design - nuclear power plant layout; reactor dynamics; reactor start up and process control, waste treatment. Risk management - assessment and management of nuclear safety; radiation, exposure and environment; safety assessment.

Enrollment Requirement for EEEN4030: Not for students who have taken ENER4030 or ESTR4404.

Enrollment Requirement for ENER4030: Not for students who have taken ESTR4404.

EEEN4050/ENER4050 Energy Storage Devices and Systems *(ENER-courses are recoded to EEEN-courses for students admitted in 2016-17 and thereafter)*
Fundamental principles, device and system designs of energy storage technologies: electrochemical energy storage (batteries, supercapacitors, fuel cells etc.), thermal energy storage (phase change), mechanical energy storage (flywheel and compressed air energy storage), hydrogen storage. The applications of energy storage technologies in supporting renewable energy sources for smart grid and green building applications. The applications of energy storage technologies in hybrid and all-electric vehicles technologies.

Enrollment Requirement for EEEN4050: Not for students who have taken ENER4040, ENER4050, ESTR4406 or ESTR4422. Pre-requisite: ENER2010 and ENER2020, or EEEN2020, or with the consent of the course instructor.

Enrollment Requirement for ENER4050: Not for students who have taken ENER4040, ESTR4406 or ESTR4422. Pre-requisite: ENER2010 and ENER2020, or with the consent of the course instructor.

EEEN4060/ENER4060 Energy Distribution *(ENER-courses are recoded to EEEN-courses for students admitted in 2016-17 and thereafter)*
Power system fundamental, control, and operation. The contents include selected topics from the following: power system components and overview, review of basic circuit elements, AC circuit analysis and phasor representation, nodal analysis, complex power, active and reactive power, power factor and power triangle, reactive power compensation, balanced 3-phase system analysis, Y-connection and delta-connection, transformer modelling and analysis, per-unit analysis, transient stability and analysis, voltage stability and control, frequency stability and control, power flow analysis, economic dispatching, optimal power flow problem, unit commitment problem, electricity market, power plant planning, demand forecast, smart grid, energy storage system, renewable generation and utilization, and electric vehicle integration.

Enrollment Requirement for EEEN4060: Not for students who have taken ENER4040, ENER4060, ESTR4406 or ESTR4424. Pre-requisite: ELEG2202.

Enrollment Requirement for ENER4060: Not for students who have taken ENER4040, ESTR4406 or ESTR4424. Pre-requisite: ELEG2202.

ENER4040 Energy Storage and Distribution *(applicable to students admitted in 2014-15 or before)*
Introduction to energy storage technologies: electrical energy storage (battery, supercapacitor etc.), thermal energy storage (phase change), mechanical energy storage (flywheel and compressed air energy storage), hydrogen storage for fuel cells. Infrastructure for energy distribution; smart grid; charging systems for electric vehicles and fuel cell vehicles.

Enrollment Requirement: Not for students who have taken ESTR4406. Prerequisites: ENER2010 and ENER2020 or with the consent of the course instructor.

ENGG5402 Advanced Robotics
Lagrange formulation of robot dynamics, Newton-Euler equations; motion control, force control, visual servoing, grasping analysis, object manipulation; sensors and sensor networks, medical robotics, advanced topics in recent development of robotic theory and applications. (Equivalent to MAEG5010 or BMEG5100.)

Enrollment Requirement: For students in MSc Mechanical and Automation Engineering or MPhil-PhD programmes under Faculty of Engineering; or For undergraduate students in Mechanical and Automation Engineering; Not for students who have taken MAEG5010 or BMEG5100

[Equivalent to MAEG5010 Advanced Robotics]
Lagrange formulation of robot dynamics, Newton-Euler equations; motion control, force control,

visual servoing, grasping analysis, object manipulation; sensors and sensor networks, advanced topics in recent development of robotic theory and applications. (Equivalent to ACE5030)

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering; or For students in MPhil-PhD Mechanical and Automation Engineering; For students in MSc Mechanical and Automation Engineering; or For students in UG Mechanical and Automation Engineering

ENGG5403 Linear System Theory & Design

Review on linear algebra; Linear system model and properties; State space representation: equivalent systems, canonical forms, realization, discrete-time systems; Stability: definitions, Lyapunov Theorem; Controllability and Observability: Grammians, canonical decomposition, sampling effects; Minimal realizations; State-Feedback and State-estimators: regulation and tracking, state estimator feedback, reduced-order estimator, multivariable system; Pole placement and Model Matching. (Equivalent to MAEG 5020.)

Enrollment Requirement: For students in MSc Mechanical and Automation Engineering or MPhil-PhD programmes under Faculty of Engineering; or For undergraduate students in Mechanical and Automation Engineering; Not for students who have taken MAEG5020 or MAEG5725

[Equivalent to MAEG5020 Topics in Linear Control Systems]

Advanced topics in recent development of linear control theory and its applications. The detailed course contents may be changed from year to year depending on the current development. (Equivalent to ACE5050)

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering or MPhil-PhD Mechanical and Automation Engineering or MSc Mechanical and Automation Engineering or UG Mechanical and Automation Engineering; Not for students who have taken MAEG5725

ENGG5405 Theory of Engineering Design

Introduction of engineering design and design procedure, design innovation and TRIZ, axiomatic design, nature's design and complex systems, design analysis (modeling and simulation), statistical analysis, design optimization, statistical design optimization, Design for Six Sigma (DFSS). Practical examples of design and applications, such as pendulum, bicycle, windmill and propulsion. (Equivalent to MAEG5100.)

Enrollment Requirement: For students in MSc Mechanical and Automation Engineering or MPhil-PhD programmes under Faculty of Engineering; or For undergraduate students in Mechanical and Automation Engineering; Not for students who have taken MAEG5100

[Equivalent to MAEG5100 Advanced Engineering Design and Optimization]

To provide in-depth understanding of the principles and tools of engineering system design, statistical optimization methods, Design for Six Sigma (DFSS), TRIX, and complex system design.

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering; or For students in MPhil-PhD Mechanical and Automation Engineering; or For students in MSc Mechanical

and Automation Engineering; or For students in UG Mechanical and Automation Engineering

MAEG4010 Computer-Integrated Manufacturing
Concurrent engineering. Computer-integrated manufacturing models and concepts. Rapid prototyping. Computer-aided manufacturing. Control of manufacturing systems: numerical control and computer numerical control; programmable logic controller; computer aided process planning and manufacturing scheduling; quality assurance. Hands-on experiments/projects.

Enrollment Requirement: Not for students who have taken ESTR4408.

MAEG4020 Finite Element Modelling and Analysis
Finite element method. Computational procedures. Basic elements. Shape functions. Formulation techniques. Boundary conditions. Modelling considerations. Implementation of finite elements. Software use. Engineering applications.

Enrollment Requirement: Not for students who have taken ESTR4410.

MAEG4030 Heat Transfer
Basic concepts. Steady and transient heat conduction. Natural and forced convection. Radiation. Numerical methods.

Enrollment Requirement: Not for students who have taken ESTR4412.

MAEG4040 Mechatronic Systems
Physical system modelling and analysis. Measurement and manipulation principles. Sensors. Actuators. Signal conditioning. Data acquisition and conversion. Microcontrollers and interface. Control system design and tuning. Case studies in system integration.

Enrollment Requirement: Not for students who have taken ESTR4414.

MAEG4050 Modern Control Systems Analysis and Design
Continuous and discrete domain state space representations: transition matrix; stability; controllability and observability; pole placement control; state estimator. Emulation designs. Discrete design. Case studies.

Enrollment Requirement: Not for students who have taken ESTR4416.

MAEG4060 Virtual Reality Systems and Applications
Introduction of virtual reality in engineering applications. Sensors and actuators. Principle and mechanism of VR equipments. Model representation in VR. Computational physics in virtual reality. Real-time rendering. Virtual prototyping. Applications in engineering analysis and simulation.

MAEG4070 Engineering Optimization
Basic concepts of engineering optimization. Formulation of engineering problems as optimization problems. Method of Lagrange multipliers. Optimality conditions. Unconstrained and constrained optimization. Dynamic programming.

Enrollment Requirement: Not for students who have taken ESTR4418.

MAEG4080 Introduction to Combustion

Fundamentals of combustion science: combustion kinetics; thermochemistry; flame dynamics and stability; pollutant formation. Internal combustion engine: operation of internal combustion engines; combustion theory for engine design; engine performance; fuel requirements; heat transfer; frictions; fuel properties; environmental impact.

Enrollment Requirement: Pre-requisite: MAEG2030 or ESTR2402. Not for students who have taken ESTR4420.

MAEG5010 Advanced Robotics

Lagrange formulation of robot dynamics, Newton-Euler equations; motion control, force control, visual servoing, grasping analysis, object manipulation; sensors and sensor networks, advanced topics in recent development of robotic theory and applications. (Equivalent to ACE5030)

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering; or For students in MPhil-PhD Mechanical and Automation Engineering; For students in MSc Mechanical and Automation Engineering; or For students in UG Mechanical and Automation Engineering

[Equivalent to ENGG5402 Advanced Robotics]

Lagrange formulation of robot dynamics, Newton-Euler equations; motion control, force control, visual servoing, grasping analysis, object manipulation; sensors and sensor networks, medical robotics, advanced topics in recent development of robotic theory and applications. (Equivalent to MAEG5010 or BMEG5100.)

Enrollment Requirement: For students in MSc Mechanical and Automation Engineering or MPhil-PhD programmes under Faculty of Engineering; or For undergraduate students in Mechanical and Automation Engineering; Not for students who have taken MAEG5010 or BMEG5100

MAEG5020 Topics in Linear Control Systems

Advanced topics in recent development of linear control theory and its applications. The detailed course contents may be changed from year to year depending on the current development. (Equivalent to ACE5050)

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering or MPhil-PhD Mechanical and Automation Engineering or MSc Mechanical and Automation Engineering or UG Mechanical and Automation Engineering; Not for students who have taken MAEG5725

[Equivalent to ENGG5403 Linear System Theory & Design]

Review on linear algebra; Linear system model and properties; State space representation: equivalent systems, canonical forms, realization, discrete-time systems; Stability: definitions, Lyapunov Theorem; Controllability and Observability: Grammians, canonical decomposition, sampling effects; Minimal realizations; State-Feedback and State-estimators: regulation and tracking, state estimator feedback, reduced-order estimator, multivariable system; Pole placement and Model Matching. (Equivalent to MAEG 5020.)

Enrollment Requirement: For students in MSc Mechanical and Automation Engineering or MPhil-PhD programmes under Faculty of Engineering; or For undergraduate students in Mechanical and Automation Engineering; Not for students who have taken MAEG5020 or MAEG5725

MAEG5030 Topics in Computer-Aided Geometric Design
Advanced topics in recent development of computer-aided geometric design. The detailed course contents may be changed from year to year depending on the current development. (Equivalent to ACE5010)

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering; or For students in MPhil-PhD Mechanical and Automation Engineering; or For students in MSc Mechanical and Automation Engineering; or For students in UG Mechanical and Automation Engineering.

MAEG5040 Computer Vision *(applicable to students admitted in 2015-16 and before)*
Camera models. Stereo vision, camera calibration and stereo calibration. Shape from motion, camera motion estimation and motion tracking. Shape from boundary. Active range sensing. Early vision. Multimedia applications like image transfer and image mosaic construction. Industrial applications. (Equivalent to ACE5020)

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering or MPhil-PhD Mechanical and Automation Engineering or MSc Mechanical and Automation Engineering or UG Mechanical and Automation Engineering; Not for students who have taken MAEG5720

MAEG5060 Computational Intelligence
Concepts, models, methods, and applications of computational intelligence. Topics include neural networks, support vector machines, fuzzy systems, simulated annealing, genetic algorithms, and their applications to control, robotics, automation, manufacturing, and transportation.

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering or MPhil-PhD Mechanical and Automation Engineering or MSc Mechanical and Automation Engineering or UG Mechanical and Automation Engineering; Not for students who have taken MAEG5735

MAEG5070 Nonlinear Control Systems
Ordinary differential equation description of nonlinear state space systems. Phase plane analysis. Linearization. Concepts of stability. Lyapunov theory. LaSalle theory. Limit cycles. Feedback linearization. Sliding mode control. Backstepping. (Equivalent to ACE5100)

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering; or For students in MPhil-PhD Mechanical and Automation Engineering; or For students in MSc Mechanical and Automation Engineering; or For students in UG Mechanical and Automation Engineering

MAEG5090 Topics in Robotics

One or more of the following topics will be discussed in the class. Advanced robot control: adaptive control; cooperative robot control; underactuated robot control; multi-finger hand control. Mobile robot: obstacle avoidance; learning; control; and mobile manipulators. Space robotics: dynamics; control; telescience. Human and robot interaction: interface; learning skills. Biorobotics: robots and intelligent systems for medical, healthcare, and laboratory automation and clinic surgery. Robot motion planning: configuration space; search algorithm; potential field, and sensor-based motion planning. (Equivalent to ACE5110)

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering; or For students in MPhil-PhD Mechanical and Automation Engineering; or For students in MSc Mechanical and Automation Engineering; or For students in UG Mechanical and Automation Engineering.

MAEG5100 Advanced Engineering Design and Optimization

To provide in-depth understanding of the principles and tools of engineering system design, statistical optimization methods, Design for Six Sigma (DFSS), TRIX, and complex system design. To provide in-depth understanding of the principles and tools of engineering system design, statistical optimization methods, Design for Six Sigma (DFSS), TRIX, and complex system design.

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering; or For students in MPhil-PhD Mechanical and Automation Engineering; or For students in MSc Mechanical and Automation Engineering; or For students in UG Mechanical and Automation Engineering

[Equivalent to ENGG5405 Theory of Engineering Design]

Introduction of engineering design and design procedure, design innovation and TRIZ, axiomatic design, nature's design and complex systems, design analysis (modeling and simulation), statistical analysis, design optimization, statistical design optimization, Design for Six Sigma (DFSS). Practical examples of design and applications, such as pendulum, bicycle, windmill and propulsion. (Equivalent to MAEG5100.)

Enrollment Requirement: For students in MSc Mechanical and Automation Engineering or MPhil-PhD programmes under Faculty of Engineering; or For undergraduate students in Mechanical and Automation Engineering; Not for students who have taken MAEG5100

MAEG5110 Quantum Control

Mathematics foundation: Hilbert spaces; manifolds; groups; Lie groups and Lie algebras. Physics foundation: quantum phenomena; states and operators; observables and measurement; quantum dynamics. Quantum control systems: modeling; controllability and observability; optimal quantum control.

Enrollment Requirement: For students in PhD Automation and Computer-Aided Engineering; or For students in MPhil-PhD Mechanical and Automation Engineering; or For students in MSc Mechanical and Automation Engineering; or For students in UG Mechanical and Automation Engineering