MECHANICAL ENGINEERING

SYLLABUS

The syllabus applies to students admitted in the academic year 2013-14 under the four-year curriculum.

Definition and Terminology

Each course offered by the Department of Mechanical Engineering shall be classified as either introductory level course or advanced level course.

A Discipline Core course is a compulsory course which a candidate must pass in the manner provided for in the Regulations.

A Disciplinary Elective course refers to any technical course offered by the Department of Mechanical Engineering for the fulfillment of the curriculum requirements of the degree of BEng in Mechanical Engineering that are not classified as discipline core course.

Curriculum

The Curriculum comprises 240 credits of courses as follows:

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

Discipline Core Courses
Students are required to complete ALL discipline core courses (78 credits), comprising 36 credits of introductory core courses and 42 credits of advanced core courses.

Disciplinary Elective Courses
Students are required to complete at least 42 credits of disciplinary elective courses offered by the Department of Mechanical Engineering.

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

University Requirements
Students are required to complete:

a) Two English language courses, “CAES1000 Core University English” and “CAES9543 Technical English for mechanical and building services engineers”, for a total of 12 credits;
b) One Chinese language enhancement course “CENG9001 Practical Chinese for engineering students”, for a total of 6 credits; and
c) 36 credits of courses in the Common Core Curriculum, selecting at least one but no more than two courses from each Area of Inquiry.

Capstone Experience
Students are required to complete the 12-credit Integrated capstone experience to fulfill the capstone experience requirement for the degree of BEng in Mechanical Engineering.

Engineering Training

Students are required to complete the 6-credit Engineering Training which normally takes place in the summer semester after their second year of study.

Degree Classification

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

The details of the distribution of the above course categories are as follows:

The curriculum of BEng in Mechanical Engineering comprises 240 credits of courses with the following structure:

UG 5 Requirements (54 credits)

Course Code	Course	No. of credits
CAES1000	Core University English	6
CAES9543	Technical English for mechanical and building services engineers	6
CENG9001	Practical Chinese for engineering students	6
CC##XXXX	University common core course (6 courses)*	36
Total for UG5 Requirements		54

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

Faculty General Engineering Courses (36 credits)

Course Code	Course	No. of credits
MATH1851	Calculus and ordinary differential equations	6
MATH1853	Linear algebra, probability & statistics	6
ENGG1111	Computer programming and applications (or the equivalent course ENGG1112 Computer programming and applications I)	6
PHYS1050	Physics for engineering students	6
ENGG1205	Introduction to mechanical engineering	6
ENGG120X	Any one of the General Engineering Courses offered by other Departments of the Faculty of Engineering*	6
Total for Faculty General Engineering Courses		36

*Choose one General Engineering Course from the following list:

ENGG1201	Engineering for sustainable development
ENGG1202	Introduction to computer science
ENGG1203	Introduction to electrical and electronic engineering
ENGG1204	Industrial management and logistics
ENGG1206	Introduction to biomedical engineering

Discipline Core Courses (78 credits)

Introductory Courses (36 credits)

Course Code	Course	No. of credits
MECH2404	Drawing and elements of design and manufacture	6
MECH2406	Fundamentals of electrical engineering	6
MECH2407	Multi-variables calculus and partial differential equations	6
MECH2413	Engineering mechanics	6
MECH2414	Thermofluids	6
MECH2419	Properties of materials	6
Total for Introductory Discipline Core Courses		36

Advanced Courses (42 credits)

Course Code	Course	No. of credits
MECH3402	Engineering thermodynamics	6
MECH3407	Advanced partial differential equation and complex variables	6
MECH3408	Mechanics of fluids	6
MECH3409	Mechanics of solids	6
MECH3418	Dynamics and control	6
MECH3427	Design and manufacture	6
MECH4410	Engineering & technology management	6
Total for Advanced Discipline Core Courses		42

Capstone Experience and Engineering Training (18 credits)

Course Code	Course	No. of credits
MECH2418	Engineering training* (Summer semester)	6
MECH4429	Integrated capstone experience+	12
Total for Capstone Experience and Engineering Training		18

+Capstone Experience
*Training

Disciplinary Elective Courses (42 credits)

Course Code	Course	No. of credits
BBSE4409	Project management and engineering economics	6
MECH3406	Electrical and electronic engineering	6
MECH3416	Fundamentals of aeronautical engineering	6
MECH3417	Industrial training* (Summer semester)	6
MECH3420	Air pollution control	6
MECH3422	Building services engineering I	6
MECH3423	Building services engineering II	6
MECH3428	Research experience for undergraduates	6
MECH4404	Automatic control	6
MECH4407	CAD/CAM	6
MECH4409	Energy conversion systems	6
MECH4411	Heat transfer	6
MECH4412	Product design and development	6

MECH4414	Materials for engineering applications	6
MECH4415	Applied stress and strength analysis	6
MECH4421	Viscous flow	6
MECH4423	Building energy management and control systems	6
MECH4428	Sound and vibration	6
MEDE4601	Biomaterials II	6
MEDE4602	Molecular and cellular biomechanics	6
MEDE4603	Transport phenomena in biological systems	6
MEDE4604	Cell and tissue engineering	6
CIME2101	Water and air quality: concepts and measurement	6
CIVL3111	Municipal and industrial waste treatment	6
CIVL3115	Solid and hazardous waste management	6
CIVL3122	Wind engineering	6
	Up to 12 credits of the following courses:	
MECH4460	Service behavior of materials	6
MECH4461	Power plant technology	6
MECH4462	Applied mathematics for engineers	6
MECH4464	Energy conservation and management	6
MECH4465	Energy and carbon audit	6
MECH4466	Nanotechnology: fundamentals and applications	6
MECH4467	Microsystem for energy, biomedical and consumer electronics applications	6
Total for Disciplinary Elective Courses		42

* Industrial training course normally takes place in the summer semester after the third year of study

Elective Courses (12 credits)

Up to 12 credits of courses offered by other departments within or outside the Faculty of Engineering.

Summary of curriculum structure of BEng in Mechanical Engineering

Course Categories	**No. of credits**
UG5 Requirements	54
General Engineering Courses	36
Discipline Core Courses (Introductory)	36
Discipline Core Courses (Advanced)	42
Capstone Experience and Engineering Training	18
Disciplinary Elective Courses	42
Elective Courses	12
Total	**240**

The proposed syllabus by study year is as follows:

FIRST YEAR

General Engineering Courses (36 credits)

MATH1851 Calculus and ordinary differential equations
MATH1853 Linear algebra, probability & statistics

ENGG1111/	Computer programming and applications/
ENGG1112	Computer programming and applications I
PHYS1050	Physics for engineering students
ENGG1205	Introduction to mechanical engineering
ENGG120X	Any one of the General Engineering Courses offered by other Departments of the Faculty of Engineering

University Requirements (UG5) (24 credits)

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

SECOND YEAR

Introductory Core Courses (36 credits)

MECH2404	Drawing and elements of design and manufacture
MECH2406	Fundamentals of electrical engineering
MECH2407	Multivariable calculus & partial differential equations
MECH2413	Engineering mechanics
MECH2414	Thermofluids
MECH2419	Properties of materials

University Requirements (UG5) (18 credits)

CC##XXXX	Three Common Core Courses

Training (6 credits)

MECH2418	Engineering training (Summer semester)

THIRD YEAR

Advanced Core Courses (36 credits)

MECH3402	Engineering thermodynamics
MECH3407	Advanced partial differential equation and complex variables
MECH3408	Mechanics of fluids
MECH3409	Mechanics of solids
MECH3418	Dynamics and control
MECH3427	Design and manufacture

University Requirements (UG5) (6 credits)

CENG9001	Practical Chinese for Engineering Students

Disciplinary Elective Courses (18 credits)

FOURTH YEAR

Advanced Core Courses (6 credits)

MECH4410	Engineering & technology management

University Requirements (UG5) (6 credits)

CAES9543	Technical English for mechanical and building services engineers

Disciplinary Elective Courses (24 credits)

Capstone Experience (12 credits)

MECH4429 Integrated capstone experience

Elective Courses (12 credits)

MINOR IN MECHANICAL ENGINEERING [not eligible for students of BEng(ME)]

Candidates from other departments in the Faculty of Engineering or from other faculties who have keen interest in Mechanical Engineering with good background in mathematics may pursue Minor in Mechanical Engineering.

Minor in Mechanical Engineering

Candidates are required to complete a total of 48 credits of courses comprising:

(a) Introductory courses (18 credits)

Students must complete 18 credits of Introductory core courses to be chosen from the following list:

Course Code	Course Title	No. of credits
MECH2404	Drawing and elements of design and manufacture	6
MECH2406	Fundamentals of electrical engineering	6
MECH2413	Engineering mechanics	6
MECH2414	Thermofluids	6
MECH2419	Properties of materials	6
Total for Introductory Discipline Core Engineering Courses		18

(b) Disciplinary Elective Courses (30 credits)

Students must complete 30 credits of disciplinary elective courses to be chosen from the following list:

Course Code	Course Title	No. of credits
MECH3402	Engineering thermodynamics	6
MECH3408	Mechanics of fluids	6
MECH3409	Mechanics of solids	6
MECH3416	Fundamentals of aeronautical engineering	6
MECH3418	Dynamics and control	6
MECH3420	Air pollution control	6
MECH3427	Design and manufacture	6
MECH4404	Automatic control	6
MECH4407	CAD/CAM	6
MECH4409	Energy conversion systems	6
MECH4411	Heat transfer	6
MECH4412	Product design and development	6
MECH4414	Materials of engineering applications	6
MECH4415	Applied stress and strength analysis	6
MECH4421	Viscous flow	6
MECH4423	Building energy management and control systems	6
MECH4428	Sound and vibration	6
Total for Disciplinary Elective Courses		30

COURSE DESCRIPTIONS

For course descriptions, please refer to the syllabuses of the Mechanical Engineering programme.

COURSE DESCRIPTIONS

Candidates will be required to do the coursework in the respective courses selected. Not all courses are offered every semester.

Faculty General Engineering Courses

ENGG1111	Computer programming (6 credits)
ENGG1112	Computer programming I (6 credits)
MATH1851	Calculus and ordinary differential equations (6 credits)
MATH1853	Linear algebra, probability & statistics (6 credits)
PHYS1050	Physics for engineering students (6 credits)
ENGG1201	Engineering for sustainable development (6 credits)
ENGG1202	Introduction to computer science (6 credits)
ENGG1203	Introduction to electrical and electronic engineering (6 credits)
ENGG1204	Industrial management and logistics (6 credits)
ENGG1205	Introduction to mechanical engineering (6 credits)
ENGG1206	Introduction to biomedical engineering (6 credits)

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

University Requirements on Language Enhancement Courses

CAES1000. Core University English (6 credits)
CENG9001. Practical Chinese for engineering students (6 credits)

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

CAES9543. Technical English for Mechanical and Building Services Engineering (6 credits)

This 6-credit English-in-the-Discipline course will introduce ME and BSE students to professional and technical communication in the context of technical project report writing and oral presentation. The course will provide an intensive English environment and engage students in activities which help them prepare for the completion of the assessments required by the Integrated capstone experience course (MECH4429). Assessment is wholly by coursework.

Co-requisite: MECH4429

Assessment: 100% continuous assessment

University Common Core Curriculum

36 credits of courses in the University Common Core Curriculum, in which students can select not more than one course from each Area of Inquiry within one academic year and at least one but no more than two courses from each Area of Inquiry during the whole period of study:

- Scientific and Technology Literacy
- Humanities
- Global Issues
- China: Culture, State and Society

COURSE DESCRIPTIONS

ENGG1205. Introduction to Mechanical Engineering

This is one of the common engineering courses offered to BEng students in their first year of study. Students who choose to study BEng in Mechanical Engineering must study this course either in their first year or second year. This course aims to provide students with a comprehensive knowledge in the nature of mechanical engineering by studying some important applications including robots, aircrafts and strong materials.

Topics include: modelling of mechanical systems; working principles of robots; mechanics and propulsion of aircrafts; strong materials; hands-on projects.

Assessment: 30% practical work, 20% continuous assessment, 50% examination

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MECH2404. Drawing and elements of design and manufacture

This course covers the basic knowledge of engineering drawing techniques and the basic concepts in product design. It introduces standard engineering drawing methods, including orthographic and pictorial projections, dimensioning and tolerancing, limits and fits. Features, functionality and representation method for screws, fasteners, cam and gear will also be covered. This course also covers computer aided drafting with 3D CAD modeling for facilitating the production of illustrations and animations in written reports and oral presentation. To help students understand the importance of design for manufacture, the working principles of basic manufacturing processes are covered in this course. This course has the objectives: (1) provide students with an ability to communicate engineering information using standard engineering drawing methods and computer-aided design tools; (2) introduce basic manufacturing processes with emphasis on design for manufacturability; and (3) help students understand how typical products are designed and manufactured so that they can be better prepared to undertake the practical engineering training course.

Topics include: engineering drawing techniques; orthographic and pictorial projections; dimensioning and tolerancing; limits and fits; screw fasteners; cam; gears; computer aided drafting with 3D CAD modeling; product design; manufacturing processes.

Assessment: 100% continuous assessment

MECH 2406. Fundamentals of electrical engineering

Basic circuit principles; steady-state A.C. circuit theory; magnetic circuits; transformers; direct-current motors; three-phase power system; induction motors; step motors.

This course aims to: (1) provide students with fundamental concepts for analysing D.C. and A.C. circuits; (2) furnish students with knowledge of the operation of transformers and D.C. motors; (3) provide students with an understanding of three-phase power system; and (4) provide students with knowledge of the principles of operation and application of A.C. motors and step motors.

Topics include: basic circuit principles; steady-state A.C. circuit theory; magnetic circuits; transformers; direct-current motors; three-phase power system; induction motors; step motors.

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

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MECH2407. Multivariable calculus & partial differential equations

This course aims to further develop the foundation of mathematics used in engineering discipline. Students will be introduced and explored to: (1) the ideas of periodic functions and their Fourier series representations; (2) the concepts of differentiation and integration of multivariable functions, and their extensions to vector analysis; and (3) the methods for solving elementary partial differential equations. Through the development of solution methods, students will enrich their experience in critical analysis and problem solving.

Topics include: Fourier series; advanced calculus; vector analysis; elementary partial differential equations.

Assessment: 20% continuous assessment, 80% examination

MECH2413. Engineering mechanics

This course aims to (1) present a comprehensive study of the fundamental concepts and methods used in the analysis of stress and strain in structural and machine components, and to develop logical methods for the design of engineering components, structures and machines; (2) develop a thorough understanding of the static deformation of simple non-rigid bodies, and of the stress and strain produced in such bodies due to various loading conditions; (3) introduce the basic principles of kinematics and kinetics for particles and rigid bodies, and (4) consolidate the knowledge of dynamics by studying space applications.

Topics include: stress and strain; bending of beams; deflection of beams; thin-walled pressure vessels; kinematics of particles and rigid bodies; kinetics and principle of momentum and energy; application of dynamics principles to space applications; particles and vehicles with mass variation; velocity-dependent resistance and the action of central forces.

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

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MECH2414. Thermofluids

Thermofluids is a branch of science and engineering, covering topics in thermodynamics and fluid mechanics. These topics form the basic foundations that govern processes in engineering applications. This course is an introduction to the thermofluids and how the principles can be applied to understand/design thermal and fluid flow processes. The specific course objectives are: (1) understand and apply thermodynamic principles to engineering applications; (2) understand basic concepts and fundamental equations in fluid mechanics, and develop skills to solve practical flow problems; and (3) form a foundation for subsequent studies in engineering thermodynamics, building services, material science, heat transfer, marine engineering, environmental engineering, power engineering, energy conversion, energy system and other areas. At the end of this course, students who fulfill the requirements of this course will be able to: (1) identify, formulate and solve thermofluids engineering problems; and (2) design and conduct experiments in thermofluids engineering, as well as to analyse and interpret data.

Topics include: concepts and definitions; properties of pure substance; heat and work; first law of thermodynamics; second law of thermodynamics; entropy; basic concepts on fluids and flows; dimensional analysis; similarity and modelling; momentum theorems and pipe flow analysis.

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

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MECH2418. Engineering training (Summer semester) (6 credits)

This course aims to provide students with hands-on training and practical experience in engineering basics, design and manufacturing practices.

Topics include: instrumentation; computation fluid dynamics; programmable logic controller; basic electrical engineering; design and model making; machining and metrology; machining practice; and seminars on safety, against corruption, engineering profession and other contemporary issues.

Assessment: 100% practical work

MECH2419. Properties of materials

In this course, students will be introduced to the underlying scientific principles of the mechanical engineering behaviour of metals, and in particular to emphasise the effects of stress and heat via their influence on the microstructure of the materials. The behaviour of materials in service conditions including stress and corrosion effects will be highlighted. The course concerns those principles governing the crystalline state, which is appropriate to metals and ceramics, as well as the amorphous and semi-crystalline states, which are relevant to polymers.

Topics include: elements of atomic structure and bonding; crystal structure; structure of polymers; solidification and phase diagrams; defects and plastic deformation in the crystalline state; TTT diagrams and heat treatment of steels; metallurgy of fatigue; corrosion resistance and surface treatment; mechanical properties of plastics.

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

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MECH3402. Engineering thermodynamics

Engineering Thermodynamics is a branch of science and engineering, covering topics in power cycles, air-conditioning, heat transfer, and combustion. The course objectives are to: (1) provide students with fundamental principles of the latest technologies of thermodynamics from a mechanical engineering perspective, and (2) enable students to apply and practice the knowledge in relevant industry and profession, such as power generation, automotive, and building services, etc. At the end of this course, students who fulfill the course requirements will be able to: (1) apply knowledge of mathematics, science, and engineering appropriate to thermodynamics, (2) identify, formulate, and solve engineering thermodynamics problems, and (3) design and conduct experiments in engineering thermodynamics, as well as to analyse and interpret data.

Topics include: IC engines; steam and gas power plants; refrigeration; jet propulsion; gas mixture; psychrometry and air-conditioning; introduction to heat transfer and combustion.

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

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MECH3406. Electrical and electronic engineering

This course aims to: (1) provide students with knowledge of solid-state electronic devices, linear circuits, digital circuits and techniques of analog / digital conversion; and (2) furnish students with knowledge of solid-state controllers for D.C. and A.C. motors.

Topics include: bipolar junction transistors; field-effect transistors; combinational logic circuits; sequential logic circuits; analog electronics; digital-to-analog and analog-to-digital converters; solid-state controller for D.C. motors; solid-state controller for A.C. motors.

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

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MECH3407. Advanced partial differential equation and complex variables

This course intends to convey mathematical techniques commonly used in disciplines relevant to mechanical engineering, e.g. heat conduction, vibration, probability, statistics, and numerical analysis. The course objectives are: (1) introduce the concepts and applications of complex variables; (2) illustrate the ideas of Fourier series and Fourier transforms; (3) obtain analytical solutions of the classical, second order partial differential equations by separation of variables, with applications of engineering interests, e.g. heat conduction and wave propagation; (4) present elementary theory of probability and statistics; and (5) discuss simple techniques in numerical analysis, e.g. solving nonlinear algebraic equations, numerical integration (quadrature), and initial value problems.

Topics include: complex variables; Fourier series and Fourier transforms; partial differential equations; introduction to probability and statistics; elementary numerical analysis.

Assessment: 20% continuous assessment, 80% examination

MECH3408. Mechanics of fluids

This course aims to: (1) provide students with an understanding of the fundamentals of the following areas of fluid mechanics: kinematics, Navier-Stokes equations, differential analysis of flows in channels and pipes, boundary layer flows, potential flows, dimensional analysis, and (2) equip students with capability of applying basic fluid mechanics principles in engineering designs.

Topics include: Navier-Stokes equations; pipe and channel viscous flows; lubrication; two-dimensional potential flows; boundary layer flows; dimensional analysis.

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

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MECH3409. Mechanics of solids

The aims of this course are: (1) to introduce the theory of elasticity for stress/strain analysis and high-light the limitations of the elementary strength of materials approach; and (2) to introduce alternate approaches for stress/strain analysis based on the numerical techniques.

Topics include: two-dimensional theory of elasticity; thermal stress and rotating disks; material failure and yielding; introduction to the finite element method; buckling; energy methods; bending of circular plate.

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

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MECH3416. Fundamentals of aeronautical engineering

Aviation is a rapidly expanding sector in developing economies like those in Asia. Aeronautical engineering is the foundation of aviation as a mode of transport. Together with space flight, aeronautics has been a driving force behind many of the modern technological development in the past century or so. This course aims to provide students with a solid foundation in the most important aspects of aircraft design and operation. The underlying science is common with many technological branches in general mechanical engineering, but it also has distinctive features that make aeronautics more challenging and interesting. For example, flow around aircraft is compressible with possible presence of shock waves while ordinary flows in engineering is low-speed and incompressible. The engine has similar thermodynamic cycles like that found in a gas turbine power plant but its main output is not derived from the turbine. Materials used in aircraft design must have the lowest possible weight for a given strength requirement. Specifically, the course will cover the following topics: aerodynamics and propulsion, materials and structures; safety and some aspects of operation and maintenance of aircrafts.

Topics include: history of aeronautical science; wing aerodynamics; propulsion; flight mechanics; systems and airframe structures; fatigue-crack growth; crack monitoring; damage tolerance; metallic materials; composites; fibre-reinforced laminates; high-temperature alloys for turbines; creep damage.

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

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MECH3417. Industrial training* (Summer semester)

This course aims to provide students with on-the-job training in local or non-local companies so that they can: (1) integrate theory learning with practical applications; (2) understand real-life organizational structure and business operation; (3) learn how to build human relations with seniors and co-workers; and (4) enrich personal resume for becoming engineering professional.

This course involves training in industry for a nominal period of at least six weeks during the summer vacation of the third year of study.

Assessment: 100% practical work

MECH3418. Dynamics and control

This course aims to provide the students with a comprehensive knowledge in advanced areas of rigid-body dynamics, theory of vibration for different types of mechanical system, dynamic system analysis techniques, basic closed-loop control system design techniques, with application to mechanical and other control systems.

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

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

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MECH3420. Air pollution control

This course aims to: (1) provide students with a basic understanding of the principles and techniques related to the formation, dispersion and control of various air pollutants formed from anthropogenic pollution sources; and (2) enable students to assess common air pollution source emissions and suggest remedial solutions to polluting sources.

Topics include: micrometeorology; air dispersion; combustion fundamentals; pollutant formation mechanism and control technologies; abatement of volatile organic compounds using incineration techniques; particulate and aerosol abatement technology; particle technology, log-normal distribution; settling chamber; cyclone; electrostatic precipitator; bag filter.

Assessment: 20% continuous assessment, 80% examination

MECH3422. Building services engineering I

Building services engineering is very important to modern societies and urban cities. Building services systems are essential installations to provide the basic functionality for occupants. This course will develop students in the basic concepts and design principles of plumbing and drainage systems including practical considerations and code requirements. It will also introduce and explain the electrical services,

lighting, lifts, escalators and security systems which are critical for making buildings comfortable, convenient and safe. This course aims to: (1) introduce the engineering concepts, design procedures, practical applications and related codes and regulations of the plumbing and drainage, electrical services, lighting, lifts, escalators and security systems, (2) develop a basic understanding of the objectives, methods and codes/standards for effective design, operation and management of these systems, and (3) enable students to design and analyse these systems for modern buildings complying with local statutory regulations and achieving effective and efficient design solutions.
Topics include: characteristics and design of plumbing and drainage systems including practical considerations and code requirements; planning and design of electrical services systems in buildings; basic concepts, design principles and energy management of lighting systems; design of lifts, escalators and security systems.

Assessment: 15% practical work, 20% continuous assessment, 65% examination

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MECH3423. Building services engineering II

Building services engineering is very important to modern societies and urban cities. This course will introduce and explain the heating, ventilating and air-conditioning (HVAC) systems which are the most important engineering systems in many types of buildings. It will also develop students in the basic concepts of fire safety, the legislative requirements and the design of most commonly installed fire service systems. This course aims to: (1) introduce the fundamental principles, engineering concepts, design procedures, practical applications and related codes/standards of HVAC and fire services systems; (2) develop a basic understanding of the objectives, characteristics, methods for effective design, operation and management of these systems, and (3) enable students to design and analyse these systems for modern buildings complying with local statutory regulations and achieving effective and efficient design solutions.

Topics include: fundamentals of heating; ventilating and air-conditioning (HVAC) engineering including psychrometry; thermal comfort; load and energy calculations; design and analysis of HVAC systems and components; fire safety and protection concepts; fire extinguishing, detection and alarm systems; smoke management and control systems; code requirements and fire risk management; fire engineering approach.

Assessment: 15% practical work, 20% continuous assessment, 65% examination

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MECH3427. Design and manufacture

The main focus of this course is on design and manufacture of engineering components and sub-systems. This course aims to: (1) provide a background for students to understand the basic procedures for designing mechanical components and sub-systems; and (2) enable students to understand the principles for material selection and design for manufacturing and assembly.

Topics include: material selection; joining and fastening; jigs and fixtures design; power transmission system design; CNC machining; rapid prototyping.

Assessment: 100% continuous assessment

MECH 3428. Research Experience for Undergraduates

This course involves undertaking a dissertation or report on a topic consisting of design, experimental or analytical investigation by individual students. The course objectives are to: (1) simulate a realistic working experience for students; (2) provide them an experience of applying engineering principles, engineering economics, business or management skills; and (3) train students to work independently to obtain an effective and acceptable solution to industry-related or research-type problems.

Assessment: 100% practical work

MECH4404. Automatic control

This course aims to provide the students with a comprehensive knowledge of continuous-time and discrete-time linear control systems, with particular reference to the modelling, analysis and design of mechanical and related control systems using both conventional and modern approaches.

Topics include: control of mechanical and electrical systems; frequency domain analysis; Nyquist stability criterion; linear control system design; computer control systems; state-space analysis of multivariable linear system; controllability and observability; stability analysis; state feedback.

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

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MECH4407. CAD/CAM

This course aims to: (1) provide students with a basic understanding of the working principles and applications of computer-aided design and manufacture (CAD/CAM) technologies; and (2) enable students practice CAD/CAM tools and techniques.

Topics include: basic data structuring techniques; transformation techniques; mathematical bases for surface modeling; principles of solid modeling and applications; numerical control; computer-aided production technologies; computer-integrated manufacturing.

Assessment: 30% continuous assessment, 70% examination

MECH4409. Energy conversion systems

This course aims to: (1) provide students with basic knowledge on energetics and development of conventional and non-conventional energy sources; and (2) develop in-depth understanding of the operation of modern power plants and an overview of energy conversion technologies.

Topics include: energy calculations; solar thermal power plant; energy storage solar photovoltaic systems; wind energy systems; nuclear energy and power plants; nuclear waste management; urban waste.

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

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MECH4410. Engineering & technology management

The objectives of this course are to: (1) master the fundamental concepts of engineering management necessary to bridge the gap between management and technology; (2) provide students with an opportunity to enhance their understanding with hands-on-skill to problem solving for decision making in different technical operations; and (3) introduce managerial models that implement qualitative as well as quantitative analyses to assist students to improve their ability and skills to analyze decision making problems.

Topics include: introduction to engineering management; functions of technology management including planning and forecasting, decision making and analysis, organizing, leading and motivation, and controlling; managing technology including research and development, engineering design, production activity and operations, marketing and service activities; quantitative analysis for management including inventory control, linear programming and queuing theory.

Assessment: 20% continuous assessment, 80% examination

MECH4411. Heat transfer

This course is on the fundamental principles of heat transfer, covering heat conduction, heat convection and heat exchangers. The course objectives are: (1) to provide an understanding of fundamental principles of heat transfer; and (2) to enable students to use the fundamental principles for conducting thermal analysis and design of engineering problems. At the end of this course, students who fulfill the requirements of this course will be able to: (1) demonstrate an understanding of the principles that govern heat transfer processes; (2) analyze heat-transfer problems quantitatively; and (3) identify relevant engineering solutions in thermal systems.

Topics include: Fourier's law; heat-conduction equation; thermal conductivity; conduction; fins; basic convection principles; laminar and turbulent heat transfer in tubes and over plates; Reynolds analogy; types of heat exchangers; overall heat-transfer coefficient; log mean temperature difference; effectiveness-NTU method; heat exchanger design.

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

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MECH4412. Product design and development

This course aims to: (1) provide the general principles and techniques related to electromechanical product design and development; and (2) enable students to practice both conventional and computer-aided product design and development methods.

Topics include: product design and manufacturing process; methods and tools used for designing and developing electromechanical products; tooling design; design for manufacture and assembly; product costing; value engineering.

Assessment: 40% continuous assessment, 60% examination

MECH4414. Materials for engineering applications

Challenging engineering environments demand special material properties if design requirements are to be met. This course is to introduce the very wide range of engineering materials which have been tailored to meet some of these requirements. Examples range from high temperature materials, materials for high specific strengths, resistance to static and dynamic loadings, plus some materials selection criteria.

Topics include: materials for high strength/weight ratio; high temperature service; resistance to corrosion resistance and protection; advanced alloys; composite and ceramic materials; problem based learning module.

Assessment: 15% continuous assessment, 85% examination

MECH4415. Applied stress and strength analysis

The aims of this course are to: (1) formulate three-dimensional theory of elasticity and introduce the theory of plasticity; (2) introduce analytical and numerical methods for solving practical engineering problems; and (3) introduce theories of fracture and fatigue and their applications to practical engineering problems.

Topics include: theory of elasticity; plastic analysis; finite element methods for two- and three-dimensional continua; rectangular plate bending; fracture mechanics.

Assessment: 15% practical work, 15% continuous assessment, 70% examination

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MECH4421. Viscous flow

This course aims to: (1) elucidate the advanced dynamics of liquids and gases, including steady and unsteady solutions of the Navier-Stokes equations, (2) perform a study on the properties, mass flux and momentum flux of a boundary layer, (3) explain the basic mechanics of a compressible fluid flow and applications to aerodynamics, (4) discuss the ideas of surface tension and stability in simple multiphase flows; To derive the Plateau-Rayleigh instability as the basic governing model for the linear stability of droplet formation, and (5) understand the complex flow patterns behind bluff bodies, mechanisms associated with vortex shedding and drag force; To characterize the low Reynolds number flow around a sphere and to measure viscosity using the Stokes' drag formula, and (6) introduce elementary concepts of turbulence.

Topics include: continuity and Navier-Stokes equations; Laminar boundary layers; Surface tension; Elementary concepts of compressible flows and shock waves; stability theory; flow behind bluff bodies; low Reynolds number flows and turbulent flows.

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

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MECH4423. Building energy management and control systems

The objectives of this course are to: (1) introduce students to the basic concepts of computer-based integrated monitoring, control and energy management for building services installations; (2) enable

students to understand the principles of design and operation of building energy management and control systems (EMCS) and their applications to modern buildings; and (3) enable students to understand modern methods of performance analysis of building services systems using building EMCS.

Topics include: concepts of distributed computer-based monitoring and control; hardware and software development; communication protocols; application to maintenance, energy management and control; system design and performance evaluation; computer simulation and emulation techniques; analysis of dynamic building services systems.

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

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MECH4428. Sound and vibration

This course aims to achieve two purposes. In the first, it is a further study of basic physical science of waves, fluid and structural dynamics. The second aim is the application of the knowledge to solving practical problems of vibration analysis and noise control; noise pollution being one of the four major environmental pollutions, namely water, air, noise and solid waste. Specifically, the following three aspects are covered in the course: (i) fundamentals of vibration and its analysis, (ii) hearing mechanisms, environmental noise sources and their mitigation, (iii) mechanisms of sound generation, propagation and control.

Topics include: fundamentals of single- and multiple degree of freedom systems; vibration modes and finite element analyses; sound radiation by vibration and flow; human hearing; sound and vibration measurements; wave propagation and duct acoustics; sound absorption and reflection; vibration isolation and noise abatement methods.

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

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MECH 4429. Integrated capstone experience

This is a compulsory, capstone experience course in the final year of the BEng in Mechanical Engineering degree programme. Students are required to undertake a group design project that runs from September to April of the following year. The project topics are stipulated either by teachers or by industrial sponsors. Each project group has two teachers acting as supervisors and an additional teacher serving as moderator. During the course of the project, supervisors communicate with the students and the concerned project sponsor to monitor the project progress. At the completion of the project, each project student presents his/her achievements to the supervisors, moderator and sponsor via a written report and an oral presentation. This course aims to: (1) provide a problem-based learning experience for students to learn how to apply scientific knowledge and team-work approach to tackle design/engineering problems systematically, and (2) strengthen students' inter-personal and communication skills through interaction with teammates, supervisors and sponsors.

Typical project activities include: problem identification & definition; research into information pertaining to the problem, design & analysis; materials sourcing; communication; conducting experiments/making prototypes for verification and demonstration of results; writing reports and giving oral presentations.

Assessment: 100% practical work

MECH4460. Service behavior of materials

This course aims to: (1) study the relevant physical basis for the understanding and prediction of the service behaviour, such as creep, fracture, fatigue and corrosion, of materials in industrial applications; and (2) provide the knowledge to engineers the microstructure in such a way that the service behaviour of materials can be improved.

Topics include: creep regimes; creep mechanisms; creep resistant alloys; brittle fracture; ductile fracture; brittle-ductile transition; fracture mechanism maps; fatigue; Basquins and Coffin-Manson Laws; Goodman's relation; Palmgren-Miner rule; corrosion; electrochemical principles; forms of corrosion; corrosion control; case studies; service behaviour of engineering plastics; polymer-matrix composites.

Assessment: 20% continuous assessment, 80% examination

MECH4461. Power plant technology

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 emission controls, environmental impact, cycle analysis, component design, plant operation and control technologies of power plant.

Topics include: sources of energy; 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.

Assessment: 30% continuous assessment, 70% examination

MECH4462. Applied mathematics for engineers

This course aims to introduce some advanced knowledge of computational and statistical analysis and methods and provide the students with the ability to apply computational and statistical methods to solve engineering problems.

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

Assessment: 20% continuous assessment, 80% examination

MECH4464. Energy conservation and management

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.

Assessment: 30% continuous assessment, 70% examination

MECH4465. Energy and carbon audit

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.

Assessment: 40% continuous assessment, 60% examination

MECH4466. Nanotechnology: fundamentals and applications

Nanotechnology is a rapidly developing discipline which has emerged from foundations based in microtechnology built up during the past few decades. Many exciting engineering applications in nanotechnology have been proposed and some are already in use. The current intensive research activities world-wide make it highly likely that many more products and applications in nanotechnology will emerge in the next few decades. This course aims at: (1) to equip students with fundamental knowledge and concepts on micro- and nano-technology, and to enable the students to apply such knowledge in future careers in both industry and universities; (2) to enable students to understand the effects of material size on behaviour and properties, and from these to appreciate the new possibilities in both fundamental science and practical applications brought about by nanotechnology; and (3) to introduce students to promising and emerging applications of nanotechnology in energy storage/conversion, unconventional materials and optical metamaterials, and help students to further research and/or work in specific application areas.

Topics include: characteristic length scales, nanomaterials, nanostructures, physical properties of nanostructures, deposition techniques of nanofabrication, micro/nanolithography, high resolution analysis and characterization, scanning probe methods, nanoindentation, mechanical behaviours of bulk nanostructured materials, processing techniques for bulk nanostructured materials, ultrahigh strength of nanostructures, bio-nanotechnology, energy storage, energy conversion, nanophotonics, plasmonics, optical metamaterial.

Assessment: 20% continuous assessment, 80% examination

MECH4467. Microsystem for energy, biomedical and consumer electronics applications

Microelectromechanical systems (MEMS) and microfluidics have gradually found numerous applications in modern energy, mechanical engineering and biomedical engineering applications. This course aims to provide students with the necessary fundamental knowledge and experience in the working principles, design, materials, fabrication and packaging, and applications of MEMS and microfluidic systems. MEMS and microfluidic devices are emerging platforms for modern engineering applications in biomedicine, chemistry, material sciences and micro-machines. This is the course that will introduce graduate students and practicing engineers into the growing field of microsystem engineering. Practical examples will be given when delivering each major topic. Teaching of the module is also strengthened with case studies on carefully chosen topics. At the end of this course, students who fulfill the requirements of this course will be able to: (1) demonstrate ability to understand the fundamental principles behind MEMS and microfluidic; (2) differentiate different MEMS and microfluidic techniques and understand their importance in modern engineering; (3) apply concepts of micro-systems for industrial applications, particularly in energy, mechanical engineering and biomedical engineering.

Topics include: MEMS and microsystem products; microsensors; microactuators; microfluidic devices; multidisciplinary nature of microsystem design and manufacture; fluid mechanics in microscaled flows; materials for MEMS and microfluidic devices; fluid mechanics in microscaled flows; fabrication techniques of MEMS and microfluidic devices; flow characterization techniques; flow control with microfluidics; microfluidics for life sciences and chemistry.

Assessment: 10% continuous assessment, 90% examination

BBSE4409. Project management and engineering economics

The objectives of this course are to: (1) understand the project management skills in building industry and other engineering projects; (2) acquire the important knowledge and experience on contract management in real life projects; (3) appreciate the techniques of project planning and control; (4) understand the skills needed for engineering economics and company finance; (5) appreciate the significance of the economic aspect of engineering in their decision making; and (6) master the fundamental concepts of economic analysis necessary to bridge the gap between the physical and economic aspects of engineering applications.

Topics include: characteristics of building projects and typical contracts; roles of different building professionals; project planning, scheduling and control; contract documentation and contractual arrangement; estimating and tendering; site organisation and supervision; measurement and valuation of works; claim management and settlement; alternative dispute resolution; time value of money; interest and interest formulas; equivalent analysis; bases for comparison of alternatives; present worth analysis; annual equivalent worth analysis; rate of return analysis; project cash flow analysis; decision making among alternatives; applications to real-world economy.

Assessment: 30% continuous assessment, 70% examination

MEDE4601. Biomaterials II
MEDE4602. Molecular and cellular biomechanics
MEDE4603. Transport phenomena in biological systems
MEDE4604. Cell and tissue engineering

For course descriptions, please refer to the syllabus of the Medical Engineering programme.

CIME2101. Water and air quality: concepts and measurement
CIVL3111. Municipal and industrial waste treatment
CIVL3115. Solid and hazardous waste management
CIVL3122. Wind engineering

For course descriptions, please refer to the syllabus of the Civil Engineering programme.
