

# **MECHANICAL ENGINEERING**

## **SYLLABUS**

The syllabus applies to students admitted in the academic year 2015-2016 and thereafter 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 Discipline 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.

#### Discipline Elective Courses

Students are required to complete at least 42 credits of discipline 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 “CAES9544 Technical English for mechanical engineering”, 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 MECH4429 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 MECH2418 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
CAES9544	Technical English for mechanical engineering	6
CENG9001	Practical Chinese for engineering students	6
CC##XXXX	University common core course (6 courses)*	36
<b>Total for UG5 Requirements</b>		<b>54</b>

\* 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.

### 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
<b>Total for General Engineering Courses</b>		<b>36</b>

\*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
ENGG1207	Foundations of biochemistry for medical 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	Multivariable calculus and partial differential equations	6
MECH2413	Engineering mechanics	6

MECH2414	Thermofluids	6
MECH2419	Properties of materials	6
<b>Total for Introductory Discipline Core Courses</b>		<b>36</b>

*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
<b>Total for Advanced Discipline Core Courses</b>		<b>42</b>

**Capstone Experience and Engineering Training (18 credits)**

Course Code	Course	No. of credits
MECH2418	Engineering training*	6
MECH4429	Integrated capstone experience+	12
<b>Total for Capstone Experience and Engineering Training</b>		<b>18</b>

+Capstone Experience

\*Training

**Discipline 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
MEDE4605	Biomaterials design and applications	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
<b>Total for Discipline Elective Courses</b>		<b>42</b>

\* 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
Discipline Elective Courses	42
Elective Courses	12
<b>Total</b>	<b>240</b>

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
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#### Training (6 credits)

MECH2418	Engineering training
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## 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
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### Discipline Elective Courses (18 credits)

## FOURTH YEAR

### Advanced Core Courses (6 credits)

MECH4410	Engineering & technology management
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### University Requirements (UG5) (6 credits)

CAES9544	Technical English for mechanical engineering
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### Discipline Elective Courses (24credits)

### Capstone Experience (12 credits)

MECH4429	Integrated capstone experience
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### Elective Courses (12 credits)

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## 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) Discipline Elective Courses (30 credits)

Students must complete 30 credits of discipline 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 Discipline Elective Courses		30

## COURSE DESCRIPTIONS

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

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## COURSE DESCRIPTIONS

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

### 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)
MECH2407	Multivariable calculus and partial differential equations (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)
ENGG1207	Foundations of biochemistry for medical engineering

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

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## **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.

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**CAES9544. Technical English for mechanical engineering (6 credits)**

This 6-credit English-in-the-Discipline course will introduce ME/ and BEng(EngSc) Materials Engineering 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 their capstone experience course. Assessment is wholly by coursework.

Co-requisite: MECH4429

Assessment: 100% continuous assessment

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## **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
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## **COURSE DESCRIPTIONS**

**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

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**MECH2406. 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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**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: 15% practical work, 20% continuous assessment, 65% 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 (6 credits)**

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

Topics include: automation & instrumentation; benchwork & machining practice; CAD/CAM; electrical & electronic engineering practice; and seminars on safety, against corruption, engineering profession and contemporary issues.

Assessment: 100% practical work

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**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

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### **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 highlight 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

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### **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

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### **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 building basic concepts, design principles and energy management of lighting systems, design of lifts, escalators and security systems.

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

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### **MECH3428. 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

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### **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

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### **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

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### **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

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#### **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

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#### **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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### **MECH4429. 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

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**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

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- MEDE4602. Molecular and cellular biomechanics**
- MEDE4603. Transport phenomena in biological systems**
- MEDE4604. Cell and tissue engineering**
- MEDE4605. Biomaterials design and applications**

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

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- 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.