Subject to approval

MECHANICAL ENGINEERING

SYLLABUS

The syllabus applies to students admitted in the academic year 2019-20 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:

Engineering Core Courses
Students are required to complete at least 42 credits of Engineering Core Courses.

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 36 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 either the Department of Mechanical Engineering, or 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, comprising at least one and not more than two courses from each Area of Inquiry with not more than 24 credits of courses being selected within one academic year, except where candidates are required to make up for failed credits during the whole period of studies.

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.

Internship

Students have the option to complete the non-credit bearing internship MECH3432 “Industrial training”, which normally takes place after their third year of study.

Degree Classification

The degree of Bachelor of Engineering shall be awarded in five divisions in accordance with EN 15 of the Regulations for the Degree of Bachelor of Engineering and UG 9 of the Regulations for 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
Total for UG5 Requirements		54

* Students have to complete 36 credits of courses in the Common Core Curriculum, comprising at least one and not more than two courses from each Area of Inquiry with not more than 24 credits of courses being selected within one academic year except where candidates are required to make up for failed credits.

Engineering Core Courses (42 credits)

Course Code	Course	No. of credits
MATH1851	Calculus and ordinary differential equations	6
MATH1853	Linear algebra, probability & statistics	6
ENGG1300	Fundamental mechanics	6
ENGG1310	Electricity and electronics	6
ENGG1320	Engineers in the modern world	6
ENGG1330	Computer programming I	6
Choose one of the following:		
ENGG1340	Computer programming II	6
ENGG1350	Thermofluid mechanics	6
Total for Engineering Core Courses		42

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
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

Discipline Elective Courses (36 credits)

Course Code	Course	No. of credits
MECH3406	Electrical and electronic engineering	6
MECH3416	Fundamentals of aeronautical engineering	6
MECH3420	Air pollution control	6
MECH3428	Research experience for undergraduates	6
MECH3429	Air conditioning and refrigeration	6
MECH3430	Fire protection in buildings	6
MECH3431	Utility services in buildings	6
MECH3432	Industrial training* (Summer semester)	0
MECH3433	Robotics, drones and autonomous ground vehicles	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
MECH4427	Innovative design and unmanned aerial systems	6
MECH4428	Sound and vibration	6
BMED4601	Biomaterials design and applications	6
BMED4602	Molecular and cellular biomechanics	6
BMED4603	Transport phenomena in biological systems	6
BMED4604	Cell and tissue engineering	6

CIME2101	Water and air quality: concepts and measurement	6
CIVL3111	Wastewater treatment	6
CIVL3115	Solid and hazardous waste management	6
CIVL3122	Wind engineering	6
Total for Discipline Elective Courses		36

* 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 either the Department of Mechanical Engineering, or other departments within or outside the Faculty of Engineering.

Elective MSc(Eng) courses
Students may take up to two 6-credit MSc(Eng) courses offered by the Department of Mechanical Engineering as elective courses, subject to the approval of the Head of Department.

Summary of curriculum structure of BEng in Mechanical Engineering

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

A suggested study plan is given as follows:

FIRST YEAR

Engineering Core Courses (42 credits)

MATH1851	Calculus and ordinary differential equations	6
MATH1853	Linear algebra, probability & statistics	6
ENGG1300	Fundamental mechanics	6
ENGG1310	Electricity and electronics	6
ENGG1320	Engineers in the modern world	6
ENGG1330	Computer programming I	6
Choose one of the following:		
ENGG1340	Computer programming II	6
ENGG1350	Thermofluid mechanics	6

University Requirements (UG5) (18 credits)

CAES1000	Core University English	6
CC##XXXX	Two Common Core Courses	12

SECOND AND THIRD YEAR

Introductory Discipline Core Courses (36 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

Training (6 credits)

MECH2418	Engineering training (Summer semester)	6

Advanced Discipline Core Courses (36 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

University Requirements (UG5) (30 credits)

CENG9001	Practical Chinese for engineering students	6
CC##XXXX	Four Common Core Courses	24

Discipline Elective Courses (12 credits) **12**

FOURTH YEAR

Advanced Discipline Core Courses (6 credits)

MECH4410	Engineering & technology management	6

University Requirements (UG5) (6 credits)

CAES9544	Technical English for mechanical engineering	6

Discipline Elective Courses (24 credits) 24

Capstone Experience (12 credits)

MECH4429	Integrated capstone experience	12

Elective Courses (12 credits) 12

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
MECH3433	Robotics, drones and autonomous ground vehicles	6
MECH3427	Design and manufacture	6
MECH3429	Air conditioning and refrigeration	6
MECH3430	Fire protection in building	6
MECH3431	Utility services in buildings	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
MECH4427	Innovative design and unmanned aerial 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.

COURSE DESCRIPTIONS

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

Engineering Core Courses

MATH1851 Calculus and ordinary differential equations (6 credits)
MATH1853 Linear algebra, probability & statistics (6 credits)
ENGG1300 Fundamental mechanics (6 credits)
ENGG1310 Electricity and electronics (6 credits)
ENGG1320 Engineers in the modern world (6 credits)
ENGG1330 Computer programming I (6 credits)
ENGG1340 Computer programming II (6 credits)
ENGG1350 Thermofluid mechanics (6 credits)

Please refer to the Engineering Core 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.

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 courses. Assessment is wholly by coursework.

Co-requisite: MECH4429

MECH4429 Integrated capstone experience (for BEng in Mechanical Engineering students)
MECH4429 Integrated capstone experience OR MECH3427 Design and manufacture (for BEng(EngSc) Materials Engineering students)

Assessment: 100% continuous assessment

University Common Core Curriculum

Successful completion of 36 credits of courses in the University Common Core Curriculum, comprising at least one and not more than two courses from each Area of Inquiry with not more than 24 credits of courses being selected within one academic year except where candidates are required to make up for failed credits:

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

Introductory Discipline Core Courses

MECH2404. Drawing and elements of design and manufacture (6 credits)

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

MECH2406. Fundamentals of electrical engineering (6 credits)

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 and partial differential equations (6 credits)

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 (6 credits)

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 (e.g. by studying space applications).

Topics include: deflection of beams; torsion of shaft; thin-walled pressure vessels; kinematics of particles and rigid bodies; kinetics and principle of momentum and energy; application of dynamics principles (e.g. space applications); particles and vehicles with mass variation; velocity-dependent resistance and the action of central forces.

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

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MECH2414. Thermofluids (6 credits)

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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MECH2419. Properties of materials (6 credits)

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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Advanced Discipline Core Courses

MECH3402. Engineering thermodynamics (6 credits)

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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MECH3407. Advanced partial differential equation and complex variables (6 credits)

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; and (4) 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; elementary numerical analysis.

Assessment: 20% continuous assessment, 80% examination

MECH3408. Mechanics of fluids (6 credits)

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 (6 credits)

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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MECH3418. Dynamics and control (6 credits)

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

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MECH3427. Design and manufacture (6 credits)

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

MECH4410. Engineering & technology management (6 credits)

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; professional ethics and corruption prevention; 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; project management; engineering economics including present worth analysis; annual equivalent worth analysis; rate of return analysis; project cash flow analysis; quantitative analysis for management including inventory control, linear programming; queuing theory.

Assessment: 20% continuous assessment, 80% examination

Capstone Experience and Training

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: automation & instrumentation; benchwork & machining practice; CAD/CAM & prototyping; electrical & electronic engineering practice; and seminars on occupational health, safety, professionalism and other contemporary issues.

Assessment: 10% practical work, 90% continuous assessment

MECH4429. Integrated capstone experience (12 credits)

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

Discipline Elective Courses

MECH3406. Electrical and electronic engineering (6 credits)

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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MECH3416. Fundamentals of aeronautical engineering (6 credits)

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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MECH3420. Air pollution control (6 credits)

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

MECH3428. Research experience for undergraduates (6 credits)

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

MECH3429. Air conditioning and refrigeration (6 credits)

Air conditioning and refrigeration is closely related to the thermal comfort and living standard in the built environment. This course describes the basic principles of air conditioning and refrigeration engineering, and discusses the design factors and practices.

The objectives of this course are to: (1) introduce students to the basic requirement for thermal comfort and good indoor air quality in the built environment; (2) enable students to understand the fundamental principles of air conditioning and refrigeration engineering; (3) study the characteristics and engineering design of heating, ventilation, air conditioning and refrigeration (HVAC&R) systems; and (4) enable students to achieve effective and efficient design solution.

Topics include: air conditioning systems; psychrometry; thermal comfort; load and energy calculations; air-side systems; fan design and other major components; air duct design; space air diffusion; water-side systems; piping system design; pump design and operation; indoor air quality; mechanical and natural ventilation; ventilation efficiency; refrigerants and refrigeration systems; refrigeration cycles and principles; design of refrigeration systems; refrigeration systems components and performance.

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

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MECH3430. Fire protection in buildings (6 credits)

Fire service installation are essential in building constructions to protect people from the damages of fire outbreak. This course will introduce the basic concepts of fire safety, legislative requirements and the design of most commonly installed fire service installation.

This course aims to: (1) introduce students to the principles of building fire safety design and fire protection engineering for modem buildings; and (2) enable students to design fire services systems for modern buildings complying with local statutory regulations under typical real-life constraints.

Topics include; fire behavior and characteristics; compartment fires; fire hazards; automatic fire detection and alarm systems; automatic fixed water-based and gas-based fire extinguishing systems; special fire extinguishing systems; portable fire extinguishers; smoke production; smoke management and control systems; staircase pressurization systems; LPC rules; HKFSD and NFPA codes; prescriptive and performance-based approaches; fire risk management.

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

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MECH3431. Utility services in buildings (6 credits)

Utility services for building constructions provide the basic functionality for occupants. These include water supply and drainage services, vertical transportation, communication, security and alarm systems. This course will develop students in the basic concepts and design principles and calculations of the service installation.

This course aims to: (1) introduce and identify the engineering concepts, design procedures, practical applications and related regulations of the main utility services, and (2) develop a basic understanding of the objectives, methods and standards for effective design and operation of the utility services.

Topics include: characteristics and design of different utility service installations; cold, hot and flushing water supply systems; steam supply; sanitary and storm water drainage systems; vertical transportation system; communication system; security and alarm.

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

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MECH3432. Industrial training (Summer semester) (0 credit)

This course aims to provide students with on-the-job training in local or non-local companies and, thus, the experiences on (1) integrating theory learned in lectures with practical applications; (2) understanding real-life organizational structure and business operation; (3) enhancing inter-personal skills with senior colleagues and co-workers; and (4) enriching their personal resume in becoming engineering professional.

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

Assessment: 100% practical work

MECH3433. Robotics, drones and autonomous ground vehicles (6 credits)

This course aims to cover : modelling of robot kinematics / dynamics; programming on robot embedded control units; characterization and specification of robot actuation; sensing interface for robot feedback control; implementation of machine intelligence algorithms

Pre-requisite courses: ENGG1300 and ENGG1310 or equivalence
Assessment: 60% practical work, 40% continuous assessment

MECH4404. Automatic control (6 credits)

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 (6 credits)

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 (6 credits)

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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MECH4411. Heat transfer (6 credits)

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

MECH4412. Product design and development (6 credits)

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 (6 credits)

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 (6 credits)

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 (6 credits)

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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MECH4427. Innovative design and unmanned aerial systems (6 credits)

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

Topics include: UAS configuration and general aviation knowledge; material selection for UAS, innovative design methodology for UAS, UAS prototyping, and tools used for designing and developing electromechanical device for UAS.

Pre-requisite courses: ENGG1300 and ENGG1310 or equivalence
Assessment: 100% continuous assessment

MECH4428. Sound and vibration (6 credits)

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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BMED4601. Biomaterials design and applications
BMED4602. Molecular and cellular biomechanics
BMED4603. Transport phenomena in biological systems
BMED4604. Cell and tissue engineering

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

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

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