

MECHANICAL ENGINEERING (with optional Environmental Engineering Stream)

SYLLABUSES

This syllabus applies to students admitted in the academic year 2011-12 and thereafter.

Definitions and Terminology

Each course offered by the Department of Mechanical Engineering shall be classified as either introductory level course or advanced level course, and be assigned a Level --- One, Two or Three, in which Level One courses are introductory courses whereas advanced courses include Level Two and Three courses.

A *Discipline Core Course* is a compulsory course which a candidate must pass in the manner provided in the Regulations. A *Project Course* is also a compulsory course which a candidate must pass. A *Breadth Course* is a Level 1, level 2 or level 3 course that is offered normally as an optional course for the curriculum. A *Depth Course* is a Level 3 course offered as an optional course for the curriculum. *Elective course* is a course offered by the Department of Mechanical Engineering, other departments under the Faculty of Engineering, or by other faculties.

The Curriculum

The curriculum comprises of 180 credits of courses as follows:

- (a) 24 credits from General Engineering courses, including:
 - (i) either ENGG1002 Computer programming and applications (6 credits) or ENGG1016 Computer programming and applications I (6 credits); AND
 - (ii) either ENGG1003 Mathematics I (6 credits) or ENGG1004 Mathematics IA (3 credits) and ENGG1005 Mathematics IB (3 credits); AND
 - (iii) ENGG1010 Foundations of engineering mechanics; AND
 - (iv) ENGG1006 Engineering for sustainable development; OR an equivalent course ENGG10XX
- (b) 72 credits of Discipline Core courses
- (c) 18 credits of Project courses
- (d) 6 credits of Breadthcourse
- (e) 39 credits of Elective courses (Main stream students); OR
12 credits of Compulsory courses and 27 credits of Elective courses (for Environmental Engineering stream students)
- (f) University requirements (21 credits), including:
 - (i) CAES1513 Professional and technical written communication for engineers (3 credits)¹
 - (ii) CAES1515 Professional and technical oral communication for engineers (3 credits)
 - (iii) CENG1001 Practical Chinese language course for engineering students (3 credits)²
 - (iv) 12 credits of courses from the University Common Core Curriculum, selecting no more than one course from each Area of Inquiry

¹ Students pursuing BEng/BBA should take CAES1907 in lieu of CAES1513

² “Putonghua-speaking students should take CUND0002 or CUND0003. Students who have not studied Chinese language during their secondary education / who have not attained the requisite level of competence in the Chinese language to take CENG1001 can apply (i) to take credit-bearing Cantonese or Putonghua language courses offered by the School of Chinese especially for international and exchange students; OR (ii) to be exempted from the Chinese language requirement and take an elective language course in lieu”.

To complete the degree curriculum, a candidate must pass all the courses listed under (a) to (f) for a combination totaling to at least 180 credits, and satisfy any other requirements as stipulated in the University or Faculty of Engineering regulations.

Degree Classification

The best 180 credits satisfying the Curriculum described above shall be taken into account for degree classification.

Order of Study

There are no course prerequisites but lower level courses should preferably be taken before higher level courses.

First Year

The first-year syllabuses shall normally include the following courses:

General Engineering Courses (Total 24 credits)

Either

ENGG1002 Computer programming and applications (6 credits); or
ENGG1016 Computer programming and applications I (6 credits); AND

Either

ENGG1003 Mathematics I (6 credits) or
both ENGG1004 Mathematics IA (3 credits) and ENGG1005 Mathematics IB (3 credits); AND

ENGG1010 Foundations of engineering mechanics (6 credits); AND
ENGG1006 Engineering for sustainable development; OR
an equivalent course ENGG10xx (6 credits)

Discipline Core Courses (Total 24 credits)

MECH1004 Drawing and elements of design and manufacture (6 credits)
MECH1005 Fundamentals of electrical and electronic engineering (6 credits)
MECH1013 Engineering mechanics (6 credits)
MECH1014 Thermofluids (6 credits)

UG5 requirements (Total 9 credits)

CAES1513 Professional and technical written communication for engineers (3 credits)¹
CAES1515 Professional and technical oral communication for engineers (3 credits)
CENG1001 Practical Chinese language course for engineering students (3 credits)²

Optional Elective Course (Total 6 credits)

MECH1018 Engineering training (6 credits) (Summer semester)

Second Year

Main Stream

The second-year syllabuses for Main Stream students shall normally include the following courses:

Discipline Core Courses (Total 48 credits)

- MECH1019 Properties of materials (6 credits)
- MECH2002 Engineering thermodynamics (6 credits)
- MECH2005 Design and manufacture (6 credits)
- MECH2006 Electrical and electronic engineering (6 credits)
- MECH2007 Mathematics II (6 credits)
- MECH2008 Mechanics of fluids (6 credits)
- MECH2009 Mechanics of solids (6 credits)
- MECH2018 Dynamics and control (6 credits)

UG5 requirements (Total 12 credits)

- 2 University Common Core Courses (12 credits)

Optional Elective Courses (Total 12 credits)

- MECH2017 Industrial training (6 credits) (Summer semester)
- MECH2019 Advanced computer programming in mechanical engineering applications (6 credits)

Environmental Engineering Stream

The second-year syllabuses for Environmental Engineering Stream students shall normally include the following courses:

Discipline Core Courses (Total 48 credits)

- MECH1019 Properties of materials (6 credits)
- MECH2002 Engineering thermodynamics (6 credits)
- MECH2005 Design and manufacture (6 credits)
- MECH2007 Mathematics II (6 credits)
- MECH2008 Mechanics of fluids (6 credits)
- MECH2009 Mechanics of solids (6 credits)
- MECH2018 Dynamics and control (6 credits)
- CIME2001 Water and air quality: concepts and measurement (6 credits)

UG5 requirements (Total 12 credits)

- 2 University Common Core Courses (12 credits)

Optional Elective Courses (Total 12 credits)

- MECH2017 Industrial training (6 credits) (Summer semester)
- MECH2019 Advanced computer programming in mechanical engineering applications (6 credits)

Third Year

Main Stream

The third-year syllabuses for Main Stream students shall normally include the following courses:

Project Courses (Total 18 credits)

MECH3008 Design (6 credits)
MECH3022 Project (12 credits)

Breadth Course (Total 6 credits)

MECH3010 Engineering and technology management (6 credits)

Elective Courses (39 credits)

Students are required to complete 36 credits of Elective courses in the following manner:

- (i) Elective Breadth/Depth Courses (up to 39 credits)
- (ii) Elective MSc(Eng) Courses (0 to 6 credits)
- (iii) Free Elective Course (0 to 6 credits)

Elective Breadth/Depth Courses (Up to 39 credits from the following)

BBSE3009	Project management and engineering economics (6 credits)
MECH2016	Fundamentals of aeronautical engineering (6 credits)
MECH2019	Advanced computer programming in mechanical engineering applications (6 credits)
MECH3002	Air pollution control (6 credits)
MECH3004	Automatic control (6 credits)
MECH3005	Building services (6 credits)
MECH3007	Computer-aided design and manufacture (CAD/CAM) (6 credits)
MECH3009	Energy conversion systems (6 credits)
MECH3011	Heat transfer (6 credits)
MECH3012	Product design and development (6 credits)
MECH3014	Materials for engineering applications (6 credits)
MECH3015	Applied stress and strength analysis (6 credits)
MECH3016	Waves in fluids (6 credits)
MECH3017	Mechatronic design methodology (6 credits)
MECH3020	Vibration (6 credits)
MECH3021	Viscous flow(6 credits)
MECH3023	Building energy management and control systems (6 credits)
MECH3024	Acoustics and noise control (6 credits)

Elective MSc(Eng) courses (Up to 6 credits)

MECH6024 Applied mathematics for engineers (3 credits)
MECH6028 Processing and properties of engineering plastics (3 credits)
MECH6040 Foundations of nanotechnology (3 credits)

Free Elective Course (Up to 6 credits)

Any other elective course as approved by the department (6 credits)

Environmental Engineering stream

The third-year syllabuses for Environmental Engineering Stream students shall normally include the following courses:

Project Courses (Total 18 credits)

MECH3008 Design (6 credits)
MECH3022 Project (12 credits)

Compulsory Breadth/Depth Courses (Total 12 credits)

MECH2006 Electrical and electronic engineering (6 credits)
MECH3002 Air pollution control (6 credits)

Breadth Course (Total 6 credits)

MECH3010 Engineering and technology management (6 credits)

Elective Courses (27 credits)

Students are required to complete 27 credits of Elective courses in the following manner:

- (i) Elective Breadth/Depth Courses (up to 27 credits)
- (ii) Elective MSc(Eng) Courses (0 to 6 credits)
- (iii) Free Elective Course (0 to 6 credits)

Elective Breadth/Depth Courses (Up to 27 credits)

BBSE3009	Project management and engineering economics (6 credits)
CIVL3011	Municipal and industrial waste treatment (6 credits)
CIVL3015	Solid and hazardous waste management (6 credits)
CIVL3022	Wind engineering (6 credits)
MECH2016	Fundamentals of aeronautical engineering (6 credits)
MECH2019	Advanced computer programming in mechanical engineering applications (6 credits)
MECH3005	Building services (6 credits)
MECH3007	Computer-aided design and manufacture (CAD/CAM) (6 credits)
MECH3009	Energy conversion systems (6 credits)
MECH3011	Heat transfer (6 credits)
MECH3012	Product design and development (6 credits)
MECH3015	Applied stress and strength analysis (6 credits)
MECH3016	Waves in fluids (6 credits)
MECH3017	Mechatronic design methodology (6 credits)
MECH3020	Vibration (6 credits)
MECH3021	Viscous flow (6 credits)
MECH3023	Building energy management and control systems (6 credits)
MECH3024	Acoustics and noise control (6 credits)

Elective MSc(Eng) courses (Up to 6 credits)

MECH6024 Applied mathematics for engineers (3 credits)
MECH6028 Processing and properties of engineering plastics (3 credits)

MECH6040 Foundations of nanotechnology (3 credits)

Free Elective Course (Up to 6 credits)

Any other elective course as approved by the department (6 credits)

Course Descriptions

Level One

MECH1004. Drawing and elements of design and manufacture (6 credits)

Engineering drawing techniques; orthographic and pictorial projections; dimensioning and tolerancing, limits and fits, screw fasteners; cam; gears; computer aided drafting, with 3D CAD modeling; manufacturing processes, process selection, design for manufacturability.

Assessment: Continuous assessment 100%.

MECH1005. Fundamentals of electrical and electronic engineering (6 credits)

Basic circuit principles; steady-state A.C. circuit theory; magnetic circuits; transformers; bipolar junction transistors; field effect transistors; direct-current motors; solid-state controller for D.C. motors; combinational logic circuits.

Assessment: Practical Work 15%; Examination 85%.

MECH1013. Engineering Mechanics (6 credits)

Stress and strain; bending of beams; deflection of beams; thin-walled pressure vessels; kinematics of particles with different forms of accelerations; momentum and energy conservation; applications of kinetic principles to particles and vehicles with mass variation; velocity-dependent resistance and the action of central forces; undamped and damped free vibration; simple and epicyclic gear trains.

Assessment: Practical Work 10%; Continuous assessment 10%; Examination 80%.

MECH1014. Thermofluids (6 credits)

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: Practical Work 10%; Examination 90%.

MECH1018. Engineering training (6 credits)

Practical work in manufacturing processes; the use of hand and machine tools; joining and fastening of metals; basic electrical engineering training, programmable logic controllers; virtual instrumentation; design; modeling and prototyping, CNC machining and metrology.

Assessment: Continuous assessment 100%.

MECH1019. Properties of materials (6 credits)

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; service behaviour of plastics.

Assessment: Practical Work 10%; Examination 90%.

ENGG1002. Computer programming and applications (6 credits)

- ENGG1003. Mathematics I (6 credits)**
ENGG1004. Mathematics IA (3 credits)
ENGG1005. Mathematics IB (3 credits)
ENGG1006. Engineering for sustainable development (6 credits)
ENGG1010. Foundations of engineering mechanics (6 credits)
ENGG1016. Computer programming and applications I (6 credits)

Please refer to the General Engineering courses for details.

CENG1001. Practical Chinese language course for engineering students (3 credits)

Please refer to the University Language Enhancement Courses for details.

CAES1513. Professional and technical written communication for engineers (3 credits)

The focus of this course is the function and importance of professional and technical communication in English and specifically understanding and using written English. Topics include accessing, abstracting, analysing, organizing and summarizing information; making effective grammatical and lexical choices; technical report writing; small-scale project design and implementation.

Assessment: Continuous assessment 100%

CAES1515 Professional and technical oral communication for engineers (3 credits)

This course focuses on students developing technical and professional spoken English skills. Throughout the course, the students will give a series of presentations which will help them to improve skills such as accessing, abstracting, analyzing, organizing and summarizing information; asking questions and negotiating meanings; making effective grammatical and lexical choices and using visual aids to ensure meaning is clear. The presentations give the students an opportunity to develop the skills to talk about general issues in Engineering in the Hong Kong context, engineering theories and their practical applications and also requires them to present a detailed exploration of one aspect of engineering related to their chosen major.

Assessment: 100% Continuous assessment.

CCXXxxxx University Common Core course (6 credits)

CCXXxxxx University Common Core course (6 credits)

Level Two

MECH2002. Engineering thermodynamics (6 credits)

Steam and gas power plant; refrigeration; jet propulsion and turbomachinery; gas mixture; psychrometry and air-conditioning; introduction to heat transfer.

Assessment: Practical Work 10%; Continuous assessment 10%; Examination 80%.

MECH2005. Design and manufacture (6 credits)

Materials selection; joining and fastening; mechanism design; tooling system design; power transmission systems design; CNC machining; rapid prototyping.

Assessment: Continuous assessment 100%.

MECH2006. Electrical and electronic engineering (6 credits)

Analog electronics; sequential logic circuits; digital-to-analog and analog-to-digital converters; introduction to microcontrollers; three-phase power systems; induction motors; synchronous motors; step motors; solid-state controllers for A.C. motors.

Assessment: Practical Work 10%; Examination 90%.

MECH2007. Mathematics II (6 credits)

Complex variables; Fourier series and Fourier transforms; partial differential equations; introduction to probability and statistics; elementary numerical analysis.

Assessment: Continuous assessment 20%; Examination 80%.

MECH2008. Mechanics of fluids (6 credits)

Navier-Stokes equations; pipe and channel viscous flows; lubrication; boundary layer flows; two-dimensional potential flows; open-channel flows; fluid machines.

Assessment: Practical Work 10%; Continuous assessment 10%; Examination 80%.

MECH2009. Mechanics of solids (6 credits)

Two-dimensional theory of elasticity; thermal stress and rotating disks; energy methods; introduction to the finite element method; experimental methods; bending of circular plate.

Assessment: Practical Work 10%; Continuous assessment 10%; Examination 80%.

MECH2016. Fundamentals of aeronautical engineering (6 credits)

History of aeronautical science; wing aerodynamics; propulsion; flight mechanics; systems and airframe structures; lightweight materials, failure modes, high-temperature materials, creep damage; maintenance.

Assessment: Practical Work 10%; Continuous assessment 10%; Examination 80%.

MECH2017. Industrial training (6 credits)

Training in industry for a nominal period of at least six weeks during the summer vacation of the Second Year of Study

Assessment: Continuous assessment 100%.

MECH2018. Dynamics and control (6 credits)

Advanced rotational motion; balancing of rotating and reciprocating masses; vibration isolation and control; vibration of multi degree-of-freedom in-line systems; free transverse vibration of beams.

Modelling of physical systems; time response analysis of dynamical systems; feedback control systems; control system design and applications; stability; root locus method; analogue computer programming

Assessment: Practical Work 10%; Continuous assessment 10%; Examination 80%.

MECH2019. Advanced computer programming in mechanical engineering applications (6 credits)

Windows® Form programming in C# with user interface and graphics; group project on the application of computing to the solution of an engineering problem; interfacing a microcontroller with a window program; basic programming technique on numerical computation with SCILab for solving engineering problems.

Assessment: Continuous assessment 100%.

CIME2001. Water and air quality: concepts and measurement (6 credits)

Water quality and water pollution; standard methods of water and wastewater examination; air quality and air pollution control principles; measurement techniques in air pollution.

Assessment: Practical Work 20%; Examination 80%.

Level Three

BBSE3009. Project management and engineering economics (6 credits)

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: Continuous assessment 20%; Examination 80%.

MECH3002. Air pollution control (6 credits)

Particulate and aerosol abatement technology; gas absorption - plate and packed columns; adsorption for the removal of odours and trace gases; combustion fundamentals and abatement of volatile organic compounds using incineration techniques.

Assessment: Continuous assessment 10%; Examination 90%.

MECH3004. Automatic control (6 credits)

Control of mechanical, hydraulic and pneumatic 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: Practical Work 10%; Examination 90%.

MECH3005. Building services (6 credits)

Introduction to the construction industry; electrical supply and lighting system design; lifts and escalators; air conditioning and refrigeration; cold and hot water supply systems; stormwater and sanitary drainage systems; fire safety and protection.

Assessment: Practical Work 15%; Examination 85%.

MECH3007. Computer-aided design and manufacture (CAD/CAM) (6 credits)

Basic data structure techniques; transformation techniques; mathematical bases for surface modeling; principles of solid modeling and applications; numerical control; computer-aided production technologies; computer-integrated manufacturing.

Assessment: Continuous assessment 30%; Examination 70%.

MECH3008. Design (6 credits)

Design methodology; engineering design; design for manufacturability; prototyping; project management; design project.

Assessment: Continuous assessment 100%.

MECH3009. Energy conversion systems (6 credits)

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: Continuous assessment 10%; Examination 90%.

MECH3010. Engineering and technology management (6 credits)

Quantitative methods for engineering and technology management; managing technology through the product life cycle; planning; organizing; staffing; leading; controlling; quantitative methods for analyzing / solving decision making involving engineering and technology management problems; quantitative methods for forecasting; resource allocations subject to constraints; linear programming and simplex method; decision theory with the application of decision trees; inventory control models; queuing theory; transportation and resource allocation for business operations.

Assessment: Continuous assessment 20%; Examination 80%.

MECH3011. Heat transfer (6 credits)

Fourier's law; heat-conduction equation; steady and unsteady conduction; basic convection principles; laminar and turbulent heat transfer in tubes and over plates; Reynolds analogy; log mean temperature difference; effectiveness-NTU method; heat exchanger design; exergy analysis; optimisation of heat transfer process and system.

Assessment: Practical Work 10%; Examination 90%.

MECH3012. Product design and development (6 credits)

Product design and product development process; methods and tools for design, analysis and testing; prototype making methods and practices; design for tooling; design of electromechanical products.

Assessment: Practical Work 20%; Examination 80%.

MECH3014. Materials for engineering applications (6 credits)

Materials for high strength/weight ratio; high and low temperature service; resistance to corrosion resistance and protection; residual stresses; composite and ceramic materials; manufacturing properties; problem based learning module; introduction to materials classification.

Assessment: Continuous assessment 10%; Examination 90%.

MECH3015. Applied stress and strength analysis (6 credits)

Theory of elasticity, bending of cantilever beams, torsion of non-circular members; finite element methods; analysis of rectangular plates; fracture mechanics; elasto-plastic analysis.

Assessment: Practical Work 10%; Examination 90%.

MECH3016. Waves in fluids (6 credits)

Small amplitude waves, shallow water waves, wave forces, ship waves, harbour oscillations, mass transport.

MECH3017. Mechatronic design methodology (6 credits)

Introduction to mechatronics and robotics; applications of sensors for intelligent control; embedded microprocessor; motion generation and transfer systems, design and control; case studies.

MECH3020. Vibration (6 credits)

Vibration measurement; single- and two-plane balancing of rotors in situ, machinery condition monitoring; random vibration; digital signal analysis; matrix analysis of free and forced vibrations of multi-degree-of-freedom systems; classical analysis of beam vibration; energy methods for approximate vibration analysis.

Assessment: Practical Work 10%; Continuous assessment 10%; Examination 80%.

MECH3021. Viscous flow (6 credits)

Eulerian and Lagrangian descriptions; Navier-Stokes equations; low-Reynolds-number flows; laminar boundary layers; laminar stability theory; turbulent flows.

Assessment: Practical Work 10%; Continuous assessment 10%; Examination 80%.

MECH3022. Project (12 credits)

A dissertation or report on a topic consisting of design, experimental or analytical investigations.

Assessment: Continuous assessment 100%.

MECH3023. Building energy management and control systems (6 credits)

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: Practical Work 10%; Continuous assessment 10%; Examination 80%.

MECH3024. Acoustics and noise control (6 credits)

Human hearing; sound measurement and environmental noise legislation; wave equation, sound radiation by piston and aeroacoustic source mechanisms; sound propagation and reflection in ducts; duct modes; sound absorption mechanisms; sound reverberation in rooms and transmission through walls; physics of active noise control; introduction to vibration isolation.

Assessment: Practical Work 10%; Examination 90%.

MECH6024. Applied mathematics for engineers (3 credits)

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

Assessment: Examination 100%.

MECH6028. Processing and properties of engineering plastics (3 credits)

Viscosity of polymer melts; extrusion; injection moulding; blow moulding; joining; plating; yield criteria; environmental stress cracking; UV degradation; flame retardation; biodegradable polymers; viscoelastic behaviour of plastics; dynamic behaviour; design methods for plastics based on creep data.

Assessment: Examination 100%.

MECH6040. Foundations of nanotechnology (3 credits)

Characteristic length scales, nanomaterials, nanostructures, physical properties of nanostructures, deposition techniques of nanofabrication, high resolution analysis and characterization, scanning probe methods, nanoindentation, deformation of nanostructures, mechanical behaviours of nanocrystalline solids, ultra-high strength of nanostructures, sensors, actuators, MEMS, NEMS, functional nanomaterials, nano-scale devices, modelling and computer-aided designs, bio-nanotechnology

Assessment: Examination 100%.

CIVL3022. Wind engineering (6 credits)

CIVL3015. Solid and hazardous waste management (6 credits)

CIVL3011. Municipal and industrial wastewater treatment (6 credits)

For course descriptions, see the syllabuses of the Civil Engineering programme
