DEPARTMENT OF MECHANICAL ENGINEERING

- Undergraduate Courses
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Undergraduate Courses:

MECH 002 Academic and Professional Development I [0-1-0:0]
For Mechanical Engineering students only. This course is designed to develop students' skills in speaking to the technical and non-technical audiences that engineers will encounter in their professional careers. Oral assignments call for impromptu speeches and formal presentations. Graded P or F.

MECH 003 Academic and Professional Development II [0-1-0:0]
Continuation of MECH 002 for Mechanical Engineering students only. This course is designed to develop students' skills in speaking to the technical and non-technical audiences that engineers will encounter in their professional careers. Oral assignments call for impromptu speeches and formal presentations. Graded P or F.

MECH 098 Industrial Training [0 credit]
For Mechanical Engineering (Building Services) students only. A practical training course for a total duration of thirteen weeks covering CAD, metal cutting and fitting, foundry, forging, heat treatment, fabrication, welding, press tools, plastic technology practices, metal surface finishing, practical design appreciation, plant maintenance, building maintenance technology practice, formwork, scaffolding, electrical assembly and wiring, fire detection and warning system, electrical installation design and schedule, safety, first aid and plumbing. Graded P or F.

MECH 099 Industrial Training [0 credit]
For Mechanical Engineering students only. A practical training course for a total duration of thirteen weeks covering CAD, metal cutting and fitting, foundry, forging, heat treatment, fabrication, welding, press tools, plastic technology practices, metal surface finishing, practical design appreciation, plant maintenance, CNC and CAM practice, precision machining, industrial automation, computer control of machines, safety, first aid, and manufacturing project. Graded P or F.

MECH 101 Solid Mechanics I [3-1-0:3]
Forces, moments, equilibrium; principles of virtual work; analysis of structural members under axial load, torsion and bending; shear force and bending moment diagrams; statically indeterminate trusses; buckling and structural stability. *Exclusion*: CIVL 112

MECH 103 Mechanisms and Dynamics of Machinery [3-1-0:3]
Kinematics and kinetics of planar machinery. Linkage and machinisms, cams, gear trains. Dynamics of particles, momentum method and impact. Dynamics and dynamic balance of machinery; vibration analysis.

MECH 105 Modern Transportation Systems - How They Work [3-0-0:3]
For non-engineering students only. The propulsive, control and safety systems of modern land, sea and air transports are explained. Their construction and manufacturing methods are introduced.

MECH 106 Mechanical Engineering For Modern Life [3-0-0:3]
For non-engineering students only. Examples of modern products useful in daily life will be used to explain mechanical engineering principles and their usage in product design and manufacture. Contents include history; modern materials for transport, communication and sports etc; air conditioning and refrigeration; energy and air pollution; micro-machines and robots.

MECH 131 Thermodynamics [3-1-0:3]
Fundamental concepts; pure substance; work and heat; control volume; Ideal and real gases. First and second laws of thermodynamics. Entropy. Elementary power and refrigeration cycles.

MECH 141 Engineering Materials I [3-1-1:3]
Atomic bonding of materials; crystal structure and defects; mechanical properties of materials; phase diagrams and phase transformations; heat treatment of metals; processing and applications of metallic materials. *Exclusion*: PHYS 250

MECH 152 Design and Manufacturing I [3-1-2:4]
Introduction to the engineering design process and engineering graphics; design specification, concept generation, and concept evaluation; geometric construction, sketching, orthographic projection, auxillary views, sectioning, dimensioning, tolerancing, and working drawing.

MECH 182 Experimental Methods [1-1-2:3]
Elementary laboratory course for non-MECH engineering students to provide training in laboratory procedures, experimental methods, instrumentation, data analysis, report writing, and measurements of some fundamental physical quantities.

MECH 202 Solid Mechanics II [3-1-0:3]
Bi-axial stress state and failure criteria; thick-walled cylinders and spinning disks; bending of plates; elastic foundations; unsymmetric bending and torsion; curved beams; frame analysis; energy methods; plastic collapse and limit analysis. *Prerequisite*: MECH 101

MECH 221 Fluid Mechanics [3-1-0:3]
Fundamental concepts; hydrostatics; integral and differential equations of fluid flows; conservation of mass, momentum and energy; dimensional analysis; pipe flow; channel flow and boundary layers. *Exclusion*: CIVL 151 *Prerequisites*: MATH 100/101 and MATH 150/151

MECH 230 Energy Conversion [3-1-0:3]
Thermodynamics of combustion, chemical equilibrium, refrigeration and mixtures of gases. Analysis of power generation, propulsion systems. Performance of modern steam plants, gas turbines, internal combustion engines and refrigeration plants. *Prerequisite*: MECH 131

MECH 231 Heat Transfer [3-1-0:3]
Transient and steady heat conduction. Natural and forced convection. Radiative exchange. Introduction to computational methods. *Prerequisites*: MECH 131 and MECH 221

MECH 242 Engineering Materials II [3-1-0:3]
Structure, properties and applications of ceramics and polymers; introduction to composites; construction materials; corrosion and degradation of materials; materials selection and design considerations. *Prerequisite*: MECH 141

MECH 251 CAD/CAM [2-0-3:3]
Geometric modeling systems, data structures, NC technology, NC machining, project.

MECH 252 Design and Manufacturing II [3-1-2:4]
Engineering specification, selection of materials, design criteria. Methods of joining and assembly. Engineering components design and applications: shafts and bearing, gearing, pulleys and belts, brakes and clutches. Design for manufacturing. *Prerequisite*: MECH 152

MECH 261 Control Principles [3-1-2:4]
Introduction to system equations, block diagrams, signal flow graphs, state-space systems, transient response using convolution integral, root locus and frequency response methods. Design by root locus, frequency response and state space method. Nyquist stability test. *Exclusion*: ELEC 271

MECH 263 Electrical Technology [3-1-1:3]
Electromagnetic circuits, transformers, electromechanical energy conversion, DC machines, asynchronous and synchronous machines, special machines, transients and dynamics, three-phase circuits and power electronics, applications in electrical building services. *Exclusion*: ELEC 263 (prior to 98-99), ELEC 300N

MECH 271 Manufacturing Processes and Systems [3-0-3:3]
Introduction to the principles of manufacturing processes; process characteristics, capabilities and limitations; related machinery and equipment; automation and common aspects of manufacturing, including metrology and quality assurance. *Prerequisites*: MECH 101, MECH 141 and MECH 252

MECH 283 Laboratory I [2-1-2:3]
Introductory laboratory course to provide training in experimental techniques and laboratory procedures, data acquisition, analysis and presentation.

MECH 284 Laboratory II [1-0-6:3]
Basic laboratory course to demonstrate physical principles in mechanical engineering, and to enhance technical reporting skills. Objectives are prescribed, but original procedures and analysis are required. *Prerequisite*: MECH 283

MECH 300 Special Topics [3-0-0:3]
Covers selected topics of current interest to the Department not covered by existing courses. Offerings announced each semester.

MECH 301 Materials Failure in Mechanical Applications [3-1-0:3]
Failure analysis, brittle and ductile fracture, creep rupture, fatigue cracking, environmental degradation of materials, damage tolerance design, life predication of engineering components, case studies. *Prerequisites*: MECH 202 and MECH 242

MECH 303 Advanced Stress Analysis [3-1-0:3]
Cartesian tensors; stress, strain, displacement fields; compatibility; plane stress and plane strain; stress and displacement formulation; two dimensional problems in rectangular and polar coordinates; torsion; thermal stresses. *Prerequisite*: MECH 202

MECH 304 Noise Control [3-0-0:3]
Properties of sound. Hearing mechanism. Instrumentation and noise measurements. Sound propagation outdoor. Construction and community noise. Transportation noise. Noise assessment and control. Indoor noise and vibration problems. *Exclusion*: MECH 321 (prior to 2000-01) *Prerequisites*: MECH 131 and MECH 221

MECH 321 Air Pollution Control [3-0-0:3]
Structure of the atmosphere. Air quality in Hong Kong. Sources and fate of air pollutants. Air pollution meteorology and dispersion. Control technologies and environmental impact assessment. *Exclusion*: IBTM 523 *Prerequisite*: CIVL 151 or MECH 221

MECH 334 Air Conditioning Systems [3-0-0:3]
Introduction of heating, ventilating and air conditioning (HVAC) systems, moist air properties, heat transmission in building structures, solar radiation, air conditioning cooling load and heating load calculation, air distribution system design, indoor air quality, economic analysis, alternative cooling systems. *Prerequisite*: MECH 231

MECH 335 Indoor Air Quality in Buildings [3-0-0:3]
Indoor air pollutants in buildings and their transport dynamics with respect to building ventilation systems. Design methodology in handling indoor air quality in buildings and enclosed spaces. Building environmental assessment method. *Exclusion*: IBTM 543 *Prerequisite*: MECH 131

MECH 336 Introduction to Intelligent Building Systems [3-0-0:3]
Introduction to intelligent building and building automation, communication, safety and security systems; modeling and control of noise, illumination, mechanical transportation, electrical, electronic, fire safety subsystems; system integration and optimization with the building envelope; code of practice in design, operational characteristics and performance specifications. *Prerequisites*: MECH 131 and MECH 261

MECH 343 Materials Characterization [3-0-2:3]
Study of microstructure, morphology, and chemical compositions of engineering materials using optical, X-ray and electron methods; specimen preparation, instrumentation and case studies. *Prerequisites*: MECH 141 and MECH 242

MECH 371 Introduction to Robotics [2-0-3:3]
Rigid body motion, forward and inverse kinematics, manipulator Jacobians, force relation, dynamics and position control robot manipulators, force control and trajectory generation, collision avoidance and motion planning, robot programming languages. *Exclusions*: ELEC 374, ELEC 564

MECH 372 Introduction to Precision Engineering [3-0-0:3]
[Previous Course Code: MECH 300D] Principles of precision design, precision machining, and precision measurement; mathematical definitions and theoretical studies of tolerances for one-, two-, and three-demensional precision assemblies; applications and industrial practices. *Prerequisites*: MECH 103 and MECH 252

MECH 373 Vibration with Application in MEMS [3-0-0:3]
[Previous Course Code: MECH 300E] Single-degree-of-freedom vibration, multiple-degree-of-freedom vibration, vibration in continuous media, nonlinear vibration, numerical method and the application in MEMS design. *Background*: experience with computer programming languages like BASIC, Fortran and Matlab *Prerequisites*: MECH 103 and MECH 202

MECH 395 Co-op Program [0-0-9:3]
This course is intended to provide 3rd year UG students with practical hands-on training in the form of a co-op program in an engineering company located in Hong Kong or China. Students must obtain approval from the UG Coordinator before enrolling in the course. *Co-requisite*: MECH 398 or MECH 399

MECH 398 Final Year Design Project I [0-1-17:6]
Practice of engineering design through a group design project chosen to integrate materials covered in the curriculum. Each student will be assigned a component of a large project which may be sponsored by industry. May be graded PP. *Background*: MECH 202, MECH 231, MECH 261

MECH 399 Final Year Design Project II [0-1-17:6]
Continuation of MECH 398. *Prerequisite*: MECH 398

Postgraduate Courses:

MECH 501 Foundation of Solid Mechanics [3-0-0:3]
Continuum concept for deformation of solids; analysis of stress and strain; constitutive equations; solution of problems relevant to materials processing, fracture mechanics and structural analysis; energy methods and numerical solutions. *Background*: MECH 202, MECH 303 *Exclusion*: MESF 501

MECH 502 Engineering Plasticity [3-0-0:3]
Macroscopic descriptions of plastic behavior of materials; inelastic and visco-plastic deformation in non-metals; macroscopic 3-D constitutive relations; simple elastic-plastic problems; mechanics of metal forming; limit analysis; plastic instability. *Background*: MECH 202, MECH 303

MECH 503 Introduction to Mechanics of Defects in Solids [3-0-0:3]
[Previous Course Code: MECH 691M] This course is to present a brief integrated view on various roles of defects in mechanics of solids, introducing the basic concepts, equations and methods used in the mechanics analysis of various kinds of defects by continuum mechanics and thermodynamics approaches. Typical types of defects - crack, dislocation and second phase inclusions - are described intensively with illustrative examples provided. The applications of the theory in the mechanics analysis of fracture of engineering materials and phase transformation process in smart materials and structures are demonstrated. *Background*: MECH 303 *Prerequisite*: MECH 501

MECH 504 Thin Film Materials Science and Mechanics [3-0-0:3]
[Co-list with MATL 560] [Previous Course Code: MECH 691N] Basic knowledge of materials science and mechanics of thin films with an emphasis on the mechanical properties of thin films and failure mechanisms in microelectronic devices. *Exclusions*: MATL 560, MESF 504

MECH 505 Fracture Behavior of Polymers [3-0-0:3]
[Previous Course Code: MECH 691J] Introduction to both fundamental and practical knowledge on the microstructure, physical and mechanical behaviors, particularly the fracture behavior and toughening mechanisms, of polymers and composites. Discussions and critiques on related research activities in the literature. Case studies to help students prepare for the industry. *Background*: MECH 242 *Exclusion*: MESF 505

MECH 506 Acoustics [3-0-0:3]
Acoustic wave equation; transmission phenomena; sound measurement; aural environment; room acoustics; structure-borne sound; air-borne sound; noise criteria; noise control engineering; Noise Control Ordinance.

MECH 509 Impact Engineering [3-0-0:3]
Elastic stress waves; 1-D elastic-plastic waves; rate dependency of dynamic behavior of materials; characterization of intense dynamic loads; dynamic response of structures to impact and pulse loading; dynamic failure of structures; impact energy absorbers. *Background*: MATH 101 and MECH 103 *Exclusions*: IBTM 540, MESF 509

MECH 521 Fluid Dynamics [3-0-0:3]
Tensor notation, derivation of Navier-Stokes equations, vorticity transport, viscous flow, flow separation, boundary layer, flow instability, turbulent boundary layer, stratified flow, rotating flow. *Background*: MECH 221 *Exclusion*: MESF 521

MECH 522 Conduction Heat Transfer [3-0-0:3]
[Previous Course Code: MECH 691E] This is a course for beginning graduate students. The initial emphasis will be on the formulation of a heat transfer problem as well as the prescription of the boundary conditions. Numerical techniques are introduced. *Exclusion*: MESF 522

MECH 523 Computational Fluid Dynamics and Heat Transfer [3-0-0:3]
Numerical simulation of viscous incompressible flows and heat transfer; finite-difference and finite element methods; accuracy and stability; grid generation; stream function and primitive-variable formulations; application to internal, external flows, diffusion, convection, and dispersion problems. *Prerequisites*: MECH 231 and COMP 102

MECH 524 Liquid-Vapor Phase Change and Interfacial Phenomena [3-0-0:3]
[Previous Course Code: MECH 691L] This course is intended to make introduction to the basic elements of condensation and vaporization processes. The course emphasizes the fundamental thermodynamic and mechanical aspects of interfacial phenomena and phase transitions, although some semi-empirical treatments of boiling and condensation are also introduced. The topics include introductory concepts, interfacial tension, wetting phenomena and contact angles, transport effects and dynamic behaviors, phase stability and homogeneous nucleation, heterogeneous nucleation and bubble growth, pool boiling, external condensation, internal flow convective boiling and condensation. *Backgrounds*: MECH 131, MECH 221 and MECH 231

MECH 526 Air Pollution Meteorology [3-0-0:3]
Atmospheric boundary layer, lapse rate, stability classification, atmospheric turbulence, dispersion modeling, boundary layer wind-tunnel. *Background*: UG Fluid Mechanics *Exclusion*: IBTM 523

MECH 532 Convective Heat and Mass Transfer [3-0-0:3]
Laminar and turbulent boundary layer heat transfer by similarity, integral and superposition methods; effects of roughness, curvature, transpiration and high turbulence; forced and free convections, free-shear flows and buoyant flows; numerical methods. *Background*: MECH 231 *Prerequisite*: MECH 521

MECH 533 Thermo Fluid Flows in Porous Medium [3-0-0:3]
Governing equations in transport phenomena in porous medium, closure modeling, Darcian and non-Darcian flows, convective heat and mass transfer, thermal dispersion, thermally non-equilibrium models, onset of instability. *Prerequisite*: MECH 231

MECH 541 Advanced Mechanical Behavior of Materials [3-0-0:3]
Relationships between microstructure and mechanical behavior in crystalline materials; temperature-dependent deformation in elasticity, viscosity and creep; embrittlement, fatigue and fracture of engineering materials; strengthening mechanisms in crystalline materials. *Background*: MECH 242 *Exclusion*: MESF 541

MECH 543 Thermodynamics and Kinetics of Materials [3-0-0:3]
[Co-list with MATL 520] An advanced treatment of the thermodynamics, kinetics and transport properties in solids, solutions, surfaces, and heterogeneous reactions. *Exclusion*: MATL 520

MECH 547 Composite Technology [3-0-0:3]
Filamentary composites; metal and ceramic matrix composites; properties of fibres and matrices; micromechanics, anisotropic elasticity and laminated plate theory; failure analysis, buckling, sandwich construction, thermal, moisture, and interlaminar stresses; design concept applications.

MECH 552 CAE Systems [3-0-0:3]
Computer graphics, data structures, geometric modeling, NC cutting path planning, process planning, mesh generation techniques for analysis, computer integrated manufacturing, intelligent CAD systems. *Exclusions*: IEEM 543 (prior to 1997-98), IEEM 575, MESF 552

MECH 592 Introduction to Electronic Packaging [3-0-0:3]
[Co-list with MATL 540] [Previous Course Code: MECH 691D] The state-of-the art in IC technology, fundamental packaging architecture, types of package; packaging materials and processing technologies; substrates and PCBs; interconnection technologies; reliability testing and failure mechanisms of packaging components. *Exclusions*: EESM 592, MATL 540, MESF 592

MECH 593 Finite Element Methods [3-0-0:3]
[Co-list with CIVL 512] Finite element formulation; variational principles for structural and continuum mechanics; numerical interpolation and integration; plane stress and plane strain analysis; plate bending and three dimensional solids; solution of large systems of algebraic equations. *Background*: MECH 202, MECH 303 *Exclusions*: CIVL 512, MESF 593

MECH 594 Experimental Methods for Electronic Packaging [3-0-1:4]
[Co-list with MATL 550] Instrumentation and principles of measurement; experimental stress analysis using strain gauges and moire interferometry; scanning acoustic microscopy; X-ray imaging; mechanical testing methods for package reliability. *Exclusion*: MATL 550

MECH 595 Introduction of Microsystems: Technology and Devices [3-0-0:3]
[Previous Course Code: MECH 691H] Physics of Scaling; energy transduction, sensing and actuation principles; micro-fabrication technology and technology fundamentals; film formation, photolithography and etching; integrated microsystems and microsystems packaging. *Exclusion*: MESF 595

MECH 596 Fundamentals of Microsystems Packaging [3-0-0:3]
[Co-listed with MATL 550] [Previous Course Code: MECH 691R] The role and trends of packaging in microelectronic and microsystems; fundamentals of micoelectronics packaging; fundamentals of optoelectronics/RF/MEMS packaging; design for reliability and environment; standards and qualifications; fundamentals of failure modes and mechanism; package level reliability; board level reliability. *Exclusions*: MECH 594, MATL 550

MECH 609 Seminar in Mechanical Engineering [1-0-0:0]
Technical seminars in various disciplines of mechanical engineering; presentations are given by students, faculty, or guest speakers. Graded P or F.

MECH 691 Special Topics in Mechanical Engineering [1-3 credit(s)]
Selected topics in mechanical engineering of current interest to the Department and not covered by existing courses.

MECH 695 Independent Studies [1-3 credit(s)]
An independent research project carried out under the supervision of a faculty member. (Only one independent studies course may be used to satisfy the course requirements for any postgraduate program in the Department of Mechanical Engineering.)

MECH 697 MSc Project I [0-1-6:3]
An independent project carried out under the supervision of an ME faculty member. This course must be followed by MECH 698. A PP grade will be given at the end of MECH 697. The final grade will be given upon the completion of MECH 698.

MECH 698 MSc Project II **[0-1-6:3]**
Continuation of MECH 697. *Prerequisite*: MECH 697

MECH 699 MPhil Thesis Research
Master's thesis research supervised by a faculty member. A successful defense of the thesis leads to the grade Pass. No course credit is assigned.

MECH 799 Doctoral Thesis Research
Original and independent doctoral thesis research. A successful defense of the thesis leads to the grade Pass. No course credit is assigned.