

Courses offered by Department of Mechanical and Automation Engineering

Applicable to students admitted in 2007-08 and after

<p>ERG2014 Advanced Engineering Mathematics (Syllabus D) 3 Units; 1st term LINEAR ALGEBRA: vector spaces and subspaces; linear transformations and their matrix representations; eigenvalues and eigenvectors; symmetric and orthogonal matrices; systems of linear equations and their solutions; least-square approximation and singular value decomposition. MULTIVARIABLE CALCULUS: partial derivatives; differential, Jacobian matrix; 3-D vector space and algebra, scalar and vector fields; path integrals, double integrals, triple and surface integrals; Grad, Div, Curl; Green's theorem, Gauss's theorem, Stoke's theorem. (For Mechanical and Automation Engineering Majors only.)</p>
<p>ERG2015 Advanced Engineering Mathematics (Syllabus E) 3 Units; 2nd term COMPLEX ANALYSIS: complex functions; complex differentiation; complex integration. ORDINARY DIFFERENTIAL EQUATIONS: separable equations; linear first-order equations with constant coefficients; systems of linear differential equations; nonhomogeneous equations. PARTIAL DIFFERENTIAL EQUATIONS: Fourier series; one-dimensional wave and heat equations; Laplace's equation; Poisson's equation. (For Mechanical and Automation Engineering Majors only.)</p>
<p>MAE2010 Computer-Aided Drafting 2 Units; 1st term Introduction to concepts and skills needed to sketch and create 2D drawings and 3-D models. Introduction to CAD systems. A series of projects for students to learn and practice using various CAD packages for modelling, engineering drawing, animation and analysis. (Not for students who have taken ACE1060.)</p>
<p>MAE2020 Engineering Mechanics 3 Units; 1st term Force and moment vectors. Free-body diagrams. Equations of equilibrium. Friction. Moments of inertia. Kinematics of particles. Newton's second law. Energy and momentum methods of particles. Kinematics of rigid bodies. Dynamics of rigid bodies. Energy and momentum methods for rigid bodies. (Equivalent to ACE1100.)</p>
<p>MAE2030 Thermodynamics 3 Units; 2nd term Fundamental concepts. Pure substance. Work and heat. First and second laws of thermodynamics. Entropy. Elementary power and refrigeration cycles. Applications to air conditioning and internal combustion engines.</p>
<p>MAE2040 Basic Electronics 3 Units; 2nd term Linear circuit theory. DC and AC analysis. Op-Amps. RLC circuits. Phasor representation and frequency analysis. Introduction to semiconductor devices. Diodes and BJT transistors circuit models. Introduction to digital circuits. (Equivalent to ACE1030.)</p>
<p>MAE3010 Mechanics of Materials</p>

<p>3 Units; 1st term</p> <p>Linear elasticity. Stress and strain. Stress-strain relations. Loading and deformation. Statically indeterminate problems. Torsion. Shear forces and bending moments. Stresses in beams. Deflections of beams. (Equivalent to ACE2080.)</p>
<p>MAE3020 Manufacturing Technology</p> <p>3 Units; 2nd term</p> <p>Overview of manufacturing engineering, engineering materials, metal forming processes, machining processes, plastic injection molding processes, and assembly. Hands-on experiments / projects. (Equivalent to ACE2060.)</p>
<p>MAE3030 Fluid Mechanics</p> <p>3 Units; 2nd term</p> <p>Nature of fluids. Fluid statics. Integral and differential equations of fluid flows. Conservation of mass, momentum and energy. Dimensional analysis. Internal flow. External flow. Applications of fluid mechanics in engineering systems.</p>
<p>MAE3040 Mechanical Design</p> <p>3 Units; 2nd term</p> <p>Engineering design process. Machine design methodology. Kinematics analysis. Load analysis. Materials and manufacture. Component design. Design synthesis and optimization. Design for reliability. Human factors in design. (Equivalent to ACE2020.)</p>
<p>MAE3050 Introduction to Control Systems</p> <p>3 Units; 1st term</p> <p>Mathematical modelling and linear approximation of engineering systems. Laplace transform. Transfer function and block diagram representation. Characteristics of feedback systems. Performance specifications. Routh-Hurwitz stability criterion. Root locus design. Frequency response design. Nyquist criterion. Utilization of computer-aided analysis and design software. (Equivalent to ACE2030.)</p>
<p>MAE3060 Introduction to Robotics</p> <p>3 Units; 1st term</p> <p>Robot classification and specification. Coordinate frames and homogeneous transformations. Denavit-Hartenberg notation. Forward and inverse kinematics. Differential motion. Jacobians and statics. Singularity. Actuators, sensors, and end-effectors. Trajectory generation. Introduction to robot motion planning. (Equivalent to ACE2140)</p>
<p>MAE3070 Engineering Computer Graphics</p> <p>3 Units; 1st or 2nd term</p> <p>Elements of interactive computer graphics. Mathematical bases and manipulation of curves and surfaces. Introduction to geometric and solid modelling. Visualization techniques. Applications in industries. (Equivalent to ACE2050.)</p>
<p>MAE3080 Fundamentals of Machine Intelligence</p> <p>3 Units; 1st or 2nd term</p> <p>Data structures, sorting, and searching. Knowledge representation: state space; logical statements; rules; connectionism. Discrete problem solving by state space search. Deduction by resolution in predicate logic.</p>

<p>Inference by ruled-based systems. Mappings by networks. Principles of learning. Application examples. (Equivalent to ACE2070.)</p>
<p>MAE3910 Engineering Profession 2 Units; 1st term Introduction of engineering as a profession (different engineering fields, social responsibility, and career advancement); engineering ethics (law in Hong Kong, mainland China, UK, and US, intellectual property, company and employee relationship); professional engineering registration; engineering project management: market research and response, project scheduling (Gantt chart, PERT/CPM); company visits. (Equivalent to ACE2150.)</p>
<p>MAE3920 Engineering Design and Applications 3 Units; 2nd term The course includes a project for students to practise the following topics: engineering design process, innovation and design basics, CAD and CAE tools and applications, prototyping (mechanical workshop), prototyping (electronics workshop), quality and inspection. (Equivalent to ACE2160.)</p>
<p>MAE4010 Computer-Integrated Manufacturing 3 Units; 1st or 2nd term Concurrent engineering. Computer-integrated manufacturing models and concepts. Rapid prototyping. Computer-aided manufacturing. Control of manufacturing systems: numerical control and computer numerical control; programmable logic controller; computer aided process planning and manufacturing scheduling; quality assurance. Hands-on experiments / projects. (Equivalent to ACE3040.)</p>
<p>MAE4020 Finite Element Modelling and Analysis 3 Units; 1st or 2nd term Finite element method. Computational procedures. Basic elements. Shape functions. Formulation techniques. Boundary conditions. Modelling considerations. Implementation of finite elements. Software use. Engineering applications. (Equivalent to ACE3070)</p>
<p>MAE4030 Heat Transfer 3 Units; 1st or 2nd term Basic concepts. Steady and transient heat conduction. Natural and forced convection. Radiation. Numerical methods.</p>
<p>MAE4040 Mechatronic Systems 3 Units; 1st or 2nd term Physical system modelling and analysis. Measurement and manipulation principles. Sensors. Actuators. Signal conditioning. Data acquisition and conversion. Microcontrollers and interface. Control system design and tuning. Case studies in system integration. (Equivalent to ACE2130.)</p>
<p>MAE4050 Modern Control Systems Analysis and Design 3 Units; 1st or 2nd term Continuous and discrete domain state space representations: transition matrix; stability; controllability and observability; pole placement control; state estimator. Emulation designs. Discrete design. Case studies. (Equivalent to ACE3010.)</p>

<p>MAE4060 Virtual Reality Systems and Applications 3 Units; 1st or 2nd term Introduction of virtual reality in engineering applications. Sensors and actuators. Principle and mechanism of VR equipments. Model representation in VR. Computational physics in virtual reality. Real-time rendering. Virtual prototyping. Applications in engineering analysis and simulation. (Not for Majors of Computer Science and Computer Engineering.)</p>
<p>MAE4070 Engineering Optimization 3 Units; 1st or 2nd term Basic concepts of engineering optimization. Formulation of engineering problems as optimization problems. Method of Lagrange multipliers. Optimality conditions. Unconstrained and constrained optimization. Dynamic programming.</p>
<p>MAE4910 Final Year Project I 3 Units; 1st term This course involves a project in any area of mechanical and automation engineering. (For Mechanical and Automation Engineering Majors only.) (Equivalent to ACE3930.)</p>
<p>MAE4920 Final Year Project II 5 Units; 2nd term This course involves a project in any area of mechanical and automation engineering. (Prerequisite: MAE4910.) (Equivalent to ACE3940.)</p> <p>(Graduation Project as prescribed by MAE4910/4920 will carry a separate weight of 10% in the assessment for degree classification in Mechanical and Automation Engineering.)</p>
<p>MAE5010 Advanced Robotics 3 Units; 1st or 2nd term Lagrange formulation of robot dynamics, Newton-Euler equations; motion control, force control, visual servoing, grasping analysis, object manipulation; sensors and sensor networks, advanced topics in recent development of robotic theory and applications. (Equivalent to ACE5030.)</p>
<p>MAE5020 Topics in Linear Control Systems 3 Units; 1st or 2nd term Advanced topics in recent development of linear control theory and its applications. The detailed course contents may be changed from year to year depending on the current development. (Equivalent to ACE5050.)</p>
<p>MAE5030 Topics in Computer-Aided Geometric Design 3 Units; 1st or 2nd term Advanced topics in recent development of computer-aided geometric design. The detailed course contents may be changed from year to year depending on the current development. (Equivalent to ACE5010.)</p>
<p>MAE5040 Machine Vision 3 Units; 1st or 2nd term Camera models. Stereo vision, camera calibration and stereo calibration. Shape from motion, camera</p>

<p>motion estimation and motion tracking. Shape from boundary. Active range sensing. Early vision. Multimedia applications like image transfer and image mosaic construction. Industrial applications. (Equivalent to ACE5020.)</p>
<p>MAE5050 MEMS and Nano-Robotics 3 Units; 1st or 2nd term Introduction to MEMS/NEMS devices. Micro/Nano fabrication techniques. MEMS/NEMS design methodology. Experimental methods for Micro/Nano devices. Applications for MEMS/NEMS. Dominant physical phenomena in the Micro/Nano worlds. Micro and Nano scale robotics and assembly. (Equivalent to ACE5090.)</p>
<p>MAE5060 Computational Intelligence 3 Units; 1st or 2nd term Concepts, models, methods, and applications of computational intelligence. Topics include neural networks, support vector machines, fuzzy systems, simulated annealing, genetic algorithms, and their applications to control, robotics, automation, manufacturing, and transportation. (Equivalent to ACE5070.)</p>
<p>MAE5070 Nonlinear Control Systems 3 Units; 1st or 2nd term Ordinary differential equation description of nonlinear state space systems. Phase plane analysis. Linearization. Concepts of stability. Lyapunov theory. LaSalle theory. Limit cycles. Feedback linearization. Sliding mode control. Backstepping. (Equivalent to ACE5100.)</p>
<p>MAE5080 Smart Materials and Structures 3 Units; 1st or 2nd term Overview of smart materials technology. Characteristics of smart materials such as piezoelectric materials, magnetorheological fluids, and shape memory alloys. Smart actuators and sensors. Structural modelling and design. Dynamics and control for smart structures. Integrated system analysis. Applications in biomedical devices, precision machinery, transportation, and buildings. (Equivalent to ACE5120.)</p>
<p>MAE5090 Topics in Robotics 3 Units; 1st or 2nd term One or more of the following topics will be discussed in the class. Advanced robot control: adaptive control; cooperative robot control; underactuated robot control; multi-finger hand control. Mobile robot: obstacle avoidance; learning; control; and mobile manipulators. Space robotics: dynamics; control; telepresence. Human and robot interaction: interface; learning skills. Biorobotics: robots and intelligent systems for medical, healthcare, and laboratory automation and clinic surgery. Robot motion planning: configuration space; search algorithm; potential field, and sensor-based motion planning. (Equivalent to ACE5110.)</p>
<p>MAE5100 Advanced Engineering Design and Optimization 3 Units; 1st or 2nd term To provide in-depth understanding of the principles and tools of engineering system design, statistical optimization methods, Design for Six Sigma (DFSS), TRIZ, and complex system design.</p>
<p>MAE5110 Quantum Control 3 Units; 1st or 2nd term</p>

Mathematics foundation: Hilbert spaces; manifolds; groups; Lie groups and Lie algebras. Physics foundation: quantum phenomena; states and operators; observables and measurement; quantum dynamics. Quantum control systems: modelling; controllability and observability; optimal quantum control.