Mechanical and Automation Engineering Programme
(3-year Curriculum)

Course List

ENGG2014 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.

ENGG2015 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.

MAEG1010 Introduction to Robot Design 3 Units; 1st or 2nd term

Introduction to robots. Sensors and sensing circuits. Electrical actuators and control systems. Motion mechanisms. Robot design and rapid prototyping. Examples of industrial applications. Design and construction of a functional robot.

MAEG2010 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.

MAEG2020 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.

MAEG2030 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.

MAEG2040 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.

MAEG3010 Mechanics of Materials 3 Units; 1st term

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.

MAEG3020 Manufacturing Technology 3 Units; 2nd term

Overview of manufacturing engineering, engineering materials, metal forming processes, machining processes, plastic injection molding processes, and assembly. Hands-on experiments / projects.

MAEG3030 Fluid Mechanics 3 Units; 2nd term

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.

MAEG3040 Mechanical Design 3 Units; 2nd term

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.

MAEG3050 Introduction to Control Systems 3 Units; 1st term

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.

MAEG3060 Introduction to Robotics 3 Units; 1st term

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.

MAEG3070 Fundamentals of Computer-Aided Design 3 Units; 1st or 2nd term

Elements of interactive graphics in CAD/CAM. Mathematical bases and manipulation of curves and surfaces: parametric cubic curve, Bezier and NURBS curve, ruled surface, sweep surface, Coon’s bilinear surface, Hermite surface, Bezier and NURBS surfaces. Introduction to geometric and solid modeling: constructive solid geometry, boundary representation. Visualization for engineering simulation. Applications in design and manufacturing.

MAEG3080 Fundamentals of Machine Intelligence 3 Units; 1st or 2nd term

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. Inference by ruled-based systems. Mappings by networks. Principles of learning. Application examples.

MAEG3910 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.

MAEG3920 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.

MAEG4010 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.

MAEG4020 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.

MAEG4030 Heat Transfer 3 Units; 1st or 2nd term

Basic concepts. Steady and transient heat conduction. Natural and forced convection. Radiation. Numerical methods.

MAEG4040 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.

MAEG4050 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.

MAEG4060 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.

MAEG4070 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.

MAEG4910 Final Year Project I 3 Units; 1st term

This course involves a project in any area of mechanical and automation engineering. (Graduation Project as prescribed by MAEG4910/4920 will carry a separate weight of 10% in the assessment for degree classification in Mechanical and Automation Engineering.)

MAEG4920 Final Year Project II 5 Units; 2nd term

This course involves a project in any area of mechanical and automation engineering. (Prerequisite: MAE4910.) (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.)

MAEG5010 Advanced Robotics (postgraduate course) 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.

MAEG5020 Topics in Linear Control Systems (postgraduate course) 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.

MAEG5030 Topics in Computer-Aided Geometric Design (postgraduate course) 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.

MAEG5040 Machine Vision (postgraduate course) 3 Units; 1st or 2nd term

Camera models. Stereo vision, camera calibration and stereo calibration. Shape from motion, camera motion estimation and motion tracking. Shape from boundary. Active range sensing. Early vision. Multimedia applications like image transfer and image mosaic construction. Industrial applications.

MAEG5050 MEMS and Nano-Robotics (postgraduate course) 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.

MAEG5060 Computational Intelligence (postgraduate course) 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.

MAEG5070 Nonlinear Control Systems (postgraduate course) 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.

MAEG5080 Smart Materials and Structures (postgraduate course) 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 modeling and design. Dynamics and control for smart structures. Integrated system analysis. Applications in biomedical devices, precision machinery, transportation, and buildings.

MAEG5090 Topics in Robotics (postgraduate course) 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; telescience. 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.

MAEG5100 Advanced Engineering Design and Optimization (postgraduate course) 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), TRIX, and complex system design.

MAEG5110 Quantum Control (postgraduate course) 3 Units; 1st or 2nd term

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.