Course Code	Course Title	Unit	Semester Offered	Course Description	Learning Outcomes	Pre-requisites	Co-requisites	Preclusions	Syllabus	Assessment	Illustrative Reading List
ME1102	Engineering Principles and Practice I	4	1	This is the first of two courses that introduces students to what engineers do and the engineer's thought process. This course focuses on how systems work and fail, and how they are designed. Through both theory and hands-on activities, students are introduced to the fundamental concepts that govern engineering systems (such as forces and motion, energy, fluid flow, heat transfer and material properties). At the end of the course, students will have developed an understanding of the major topics relevant to engineering. Students will also learn to use software (e.g. Excel) to process and present data.	1. Describe a system and its components using block diagrams. 2. Use computing tools for engineering analysis and simple design. 3. Explain, visualise and compare the size and capacity of engineering components or systems using dimensional and scientific notations. 4. Construct and solve mathematical and behavioural models of engineering applications with back-of-envelope calculations. 5. Analyse a flow system where the flow involves mass (species) and energy in different domains. 6. Analyse the basic operation of a system using principles of equilibrium and system dynamics. 7. Estimate losses in a system and its impact on system performance. 8 Determine the normal operating range and estimate the operation outside that range that causes a system to fail. 9. Give clear and concise presentations. 10. Write clear and concise reports/posters.	Students from cohort AY19/20 onwards	Nil	EG1111 & RB1101	• Safety, dimensions & guesstimation • Forces and equilibrium • Bodies in motion • Energy and power • Material properties and selection • Fluid mechanics • Heat transfer	Attendance/participation in tutorials Group presentation Studio reports Final Examination	
ME2104	Engineering Principles and Practice II	4	2	This is part 2 of a 2-course package that introduces students to what engineers do and the engineer's thought process. EPP2 focuses on how systems get energy and are controlled. The topics are mostly on electrical circuits as modern systems are typically electrified and controlled by electrical circuits. Through both theory and hands-on activities, students are introduced to the fundamental concepts of electrical circuits, sensors, and actuators. At the end of the course, students will develop a basic understanding of the major topics relevant to electrical circuits and components in mechanical engineering systems.	1. Analyse DC and AC electrical circuits with linear and nonlinear elements, resistors, capacitors, and inductors. 2. Understand fundamentals of electrical circuits and able to relate to conversion of energy (mechanical and electrical) and signals in sensors and actuators. 3. Develop teamwork during hands-on project and able to write clear and concise reports.	Nil	Nil	EG1112	● Circuit Analysis ● Capacitors and Inductors ● Sensors ● AC Circuits ● DC Motors ● Robotic Car Project	Mid Term test Studio Activity: Attendance and Punctuality Weekly Studio Reports Final Examination	
ME2102	Engineering Innovation and Modelling	4	1 & 2	This course introduces the students to the various standards and techniques of sketching, prepare engineering drawings and specifications, and interpreting drawings. Students also get to use advanced commercial CAD software to do 3D solid modeling. Above all, this course expands the students' creative talent and enhances their ability to communicate their ideas in a meaningful manner. Major topics include: Principles of projections; Isometric; Orthographic and Isometric sketching; 3D solid modeling; Sectioning and Dimensioning; Welding representations, Drawing standards; Limits, Fits and Geometrical Tolerances. This course also provides the student with the fundamental knowledge to do calculations on design components like bolts, screws, fasteners, weld joints, springs, gears, material selection, fatigue, bearings and shafts. This is a 100% CA core course for all Mechanical Engineering students.	On successful completion of this course, the student will: 1. Demonstrate the basic knowledge in engineering drawing principles, tolerance, engineering conventions and representations. 2. Use advanced 3D modeling software in solid modeling. 3. Perform calculations on design components	Nil	Nil	Nil	Introduction to engineering drawing, scale, title-block Principles of projection; 1st and 3rd angles. Isometric views Sectioning and Dimensioning of parts Isometric & orthographic sketching Limits, Fits and Geometrical Tolerances Symbols for machine elements, Conventions, Keys, coupling & Locking Devices Welding symbols & representation Screws, bolts and fasteners, Weld joints, Springs, Gears Selection of materials, Design against fatigue Selection of rolling bearings Design of shafts	100% CA	
ME2112	Strength of Materials	4	1 & 2	This course provides basic mechanical engineering knowledge and theory of mechanics of materials, and how they are used to solve practical engineering problems. The course includes introduction to statics, concept of stress and strain, analysis of stresses and deflections in a loaded beam, torsion of a circular bar as well as analysis of frames and machines.	Students will be able to 1. Understand and analyse beam deflection 2. Understand and analyse stresses in a loaded beam. 3. Understand and analyse torsion of a circular bar. 4. Understand and analyse two dimensional stress system 5. Understand frames and machines in a structural component 6. Understand the concepts of statics, equilibrium of a rigid body, forces and moments	Cohort AY18/19 & before = EG1111 Cohort AY19/20 & after =ME1102	Nil	ME2113	• Introduction to Statics, Equilibrium of Rigid Bodies, Frames and machines. • Deformable Bodies; Stress and Strain and Sign Convention; Linear Elastic Stress-Strain Relationships. • Two -dimensional stress and strain systems • Shear Force and Bending Moment in Beams • Deflection of Laterally Loaded Symmetrical Beams. Statically Indeterminate Beams • Bending and Shear Stresses in Laterally Loaded Symmetrical Beams. Second moment of area. The flexure formula. • Torsion of Cylindrical Shafts	Lab Quiz Assignment Final Examination	
ME2115 (previously known as ME3112)	Mechanics of Machines	4	1 & 2	This course covers the fundamental engineering principles on kinematics and kinetics. The topics of rigid body dynamics and vibration will be covered, including the theoretical development and practical application to mechanisms and machinery. The salient features of dynamics to be applied for each instance will be clearly explained and the interpretation of the results obtained will be highlighted.	1. Understand the principles of kinematics of rigid body motion and apply them to the analysis of simple mechanisms 2. Understand the principles of kinetics of rigid body motion and apply them to the analysis of simple mechanisms. 3. Apply the knowledge of dynamics to solve mechanical vibration problems.	Cohort AY18/19 & before = PC1431 Cohort AY19/20 & after =ME1102	Nil	Nil	1. Revision for kinematics and dynamics of particles 2. Kinematics for rigid bodies 3. Kinetics for rigid bodies 4. Work and energy principle for rigid bodies 5. Vibration of single degree of freedom system 6. Analysis of mechanisms and linkages.	Lab Test Assignment Final Examination	**Supplementary reading:** **Vector Mechanics for Engineers: Dynamics** Ferdinand Beer; Phillip Cornwell; Brian Self; Jr. Johnston, E. Russell

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ME2121	Engineering Thermodynamics and Heat Transfer	4	1 & 2	This course develops a good understanding of the basic concepts and application of thermodynamics and heat transfer, required for the analysis, modeling and design of processes and thermal-fluid systems in engineering practice. Major topics include the introduction and the application of the First and Second Laws of Thermodynamics, reversible and irreversible processes, entropy, non-flow and flow processes, cycles involving entropy changes, power and refrigeration cycles, as well as convection & radiation heat transfer.	On successful completion of this course, the student will be able to: 1. Apply principles of thermodynamics in analyzing non-flow and flow processes. 2. Analyze, model and design power plants using water or air as working fluids. 3. Analyze, model and design vapour compression refrigeration systems. 4. Analyse, model and calculate heat transfer by convection and radiation in common engineering applications.	Cohort AY18/19 & before = PC1431 Cohort AY19/20 & after =ME1102	Nil	Nil	Properties of pure substances, steam tables **First Law of Thermodynamics:** First Law applied to non-flow, flow processes and cycles. Ideal gas and condensible substances. **Second Law of Thermodynamics:** Direct and reversed heat engines. Reversibility, processes and cycles. Carnot cycle. Clausius inequality. Absolute temperature. Entropy of substances. **Application to processes and cycles:** Entropy changes for pure substances in non-flow, flow processes and cycles. P-v and T-s diagrams. Isentropic efficiency. **Power and refrigeration cycles:** Water as working fluid for power cycles. Rankine cycle, superheating and reheating. Vapour compression cycle. **Air standard cycles:** Analysis of Otto, Diesel and Mixed cycles. Gas turbine cycle. **Convection & radiation heat transfer:** Convective heat transfer coefficient. Non-dimensional groups in convection. Convective boundary condition. Overall heat transfer coefficient. Introduction to radiation.	Lab, Test, Final Examination	**Compulsory reading:** Thermodynamics: An Engineering Approach by Michael Boles; Yunus Cengel **Supplementary reading:** Fundamentals of Thermodynamics by Claus Borgnakke by Richard E. Sonntag Engineering Thermodynamics by Gordon Frederick Crichton Rogers by Yon Richard Mayhew Fundamentals of Engineering Thermodynamics by Michael J. Moran; Howard N. Shapiro; Daisie D. Boettner; Margaret B. Bailey Fundamentals of Heat and Mass Transfer by Frank P. Incropera Heat and Mass Transfer by Yunus A. Cengel; Afshin Jahanshahi Ghajar Heat Transfer by Jack Philip Holman
ME2134	Fluid Mechanics I	4	1 & 2	This is an introductory course to fluid mechanics as applied to engineering. After introducing the basic terminology and a classification of fluid and flow, students are taught fluid statics, which cover hydrostatic forces on submerged bodies, surface tension forces, buoyancy, metacentric height and stability of floating bodies. Numerous examples of engineering applications pertaining to each aspect of fluid statics are presented. In the section on fluid dynamics, basic principles of fluid motion are introduced. This covers the continuity equation, Bernoulli and energy equations. The momentum equation and its engineering application using the control volume approach are included. In the analysis of fluid-mechanics problems, dimensional analysis and similitude are taught with practical engineering examples. On viscous flow in pipes, laminar and turbulent pipe flows, Hagen-Poiseuille law, friction factor, losses in pipe fittings and use of Moody's Chart will be covered.	On successful completion of this course, the student will be able to: 1. Classify different types of fluid flows, identify different flow regimes, relate stress and rate of strain in a fluid, and solve problems involving surface tension. 2. Evaluate hydrostatic forces on submerged plane or curved surfaces, identify the states of equilibrium of floating bodies and analyse their stability. 3. Analyse equilibrium of fluids undergoing rigid-body translation and rotation, and perform control volume analysis using the continuity, linear and angular momentum equations. 4. Apply the Continuity and Bernoulli equations, and appreciate the limitations of the Bernoulli equation. 5. Formulate dimensionless groups using Rayleigh's Method and Buckingham's Pi Theorem, and apply concepts of modeling and similitude. 6. Analyse energy losses and velocity distributions for laminar and turbulent flows in smooth and rough pipes, apply Moody's chart and compute minor losses in pipe systems.	Cohort AY18/19 & before = PC1431 Cohort AY19/20 & after =ME1102	Nil	Nil	1. Introduction to Fluid Mechanics. 2. Classification of Fluid and Flow: Real and ideal; Newtonian and non-Newtonian; Uniform and non-uniform; Steady and unsteady; Laminar and turbulent; Incompressible and compressible. 3. Fluid Statics: Hydrostatic forces on submerged body, buoyancy, metacentric height, stability of floating bodies. 4. Principles of Fluid Motion: Definition of streamline. Continuity equation, Bernoulli equation and Energy equations. Equilibrium of moving fluid (in translation and rotation). Momentum equation and its applications. 5. Dimensional Analysis and Similitude: Rayleigh's method, Buckingham's Π theorem, Dimensionless numbers. Type of physical similarities: geometric, kinematic and dynamic. Reynolds number, Froude number, etc and their simple applications. 6. Laminar and Turbulent Pipe Flows: Hagen-Poiseuille equation, Darcy friction factor, Darcy-Weisbach equation, turbulent flow in smooth and rough pipes, application of Moody's chart and minor losses in pipe system.	Lab reports/Assignment, Final Examination	
ME2142	Feedback Control Systems	4	1 & 2	This course introduces students to fundamental concepts in control system analysis and design. Topics include mathematical modeling of dynamical systems, time responses of first and second-order systems, steady-state error analysis, frequency response analysis of systems and design methodologies in both the time and the frequency domains.	On successful completion of this course, the student will be able to: 1. Obtain the dynamic models of simple physical systems, particularly mechanical and electrical systems and obtain the transfer functions of these systems. 2. Determine the transient response of first and second order systems. 3. Determine the stability characteristics of a system using Routh's stability criterion and the root locus method. 4. Determine the steady state error characteristics of systems. 5. Determine the steady state frequency response of physical systems and represent the frequency response graphically in terms of Bode and Nyquist plots. 6. Determine the stability of physical systems through the frequency response using the Nyquist stability criterion. 7. To determine also the relative stability measures such as gain and phase margins and to translate these values in terms of transient response. 8. To conduct simple experiments determining performance of control systems	MA1512+ MA1513	MA1512+ MA1513	ME2142E, TME2142	**1. General Introduction to Automatic Control:** Definitions. Closed-loop and Open-loop Control. Examples **2. Review of Mathematical Background:** Review of Laplace Transformation. Inverse Laplace Transformation. Solution of Differential Equations. **3. Mathematical Model of Physical Systems:** Transfer functions. Block diagrams. Modeling of mechanical systems, electrical systems, motors. **4. Transient Response Analysis:** Standard time response test functions. Time responses of first-order, second-order and higher-order systems. **5. System Stability and Steady State Characteristics:** Routh's stability criterion. Root locus Method. System Types. Steady state error analysis **6. Frequency Response Analysis:** Forced sinusoidal response. Graphical frequency response methods – Bode and Nyquist plots. Nyquist stability criterion. Gain and phase margins. Closed-loop frequency response.	Lab, Final Examination	
ME2162 (previously known as ME3162)	Manufacturing Processes	4	1 & 2	Manufacturing processes and technologies have evolved and diversified to fulfil society's ever-increasing demands for better products. In this course, students will learn how to convert raw materials into useful products through conventional and advanced manufacturing processes. They will learn to appreciate and determine the appropriate manufacturing pathways for producing specific products. The major topics that are covered include an introduction to manufacturing, metal casting, powder metallurgy and processing, bulk deformation processing, sheet metalworking, machining, cutting tool technology, welding, and additive manufacturing.	On successful completion of this course, the student will be able to: 1. Understand and illustrate the fundamental principles and characteristics of both conventional and advanced manufacturing processes. 2. Evaluate and compare the different manufacturing processes. 3. Determine the appropriate manufacturing methods for specific products. 4. Understand the operations and the execution of the manufacturing processes.	Nil	Nil	Nil	General introduction to the manufacturing processes Solidification processes, including the casting of metals, etc. Particulate processing, including powder metallurgy, ceramic processing, etc. Bulk deformation processing, including rolling, forging, extrusion, drawing, etc. Sheet metalworking, including shearing, bending, deep drawing, etc. Machining processes, including turning milling, drilling Welding processes, including arc and gas welding, pressure welding, MIG, TIG, submerged-arc, friction, resistance, laser and electron-beam welding. Additive manufacturing, including binder jetting, directed energy deposition, material extrusion, material jetting, powder bed fusion, sheet lamination, vat photopolymerization	Lab Mid term CA test Final Examination	

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ME4101B	Mechanical Systems Design (Cohort AY19/20 & after)	8	1 & 2 (across 2 semesters)	This course aims at educating students to work as a team to empathise, define, ideate, design and fabricate to respond to either one of the following: industrial projects, in-house projects linked to external competitions, and research projects. The team will comprise of not more than 5 students per team, Each student will work on the project amounting to 260 hours over two semesters.	On successful completion of this course, the student will be able to: (1) Undertake team design and research projects in a methodological manner including identifying the formulation of the problem, defining project specifications, generation of ideas, literature search, conduct experiments, and analysis. (2) Work effectively and efficiently as a team to learn from one another and to support one another. (3) Think critically and creatively and acquire both independent design and research skills that are vital for life-long learning. (4) Communicate effectively through technical report writing. (5) Achieve confidence in communication skills through continual project oral presentations and achievements.	Stage 4 standing (112Units)	Nil	ME4101 & ME4101A & EG4301	Design Thinking: Empathize, Problem Formulation, Ideation, Solution Selection, Detail Design and Prototyping. Mechanism Design. Effective Team Building. Design Communications Skills including presentation and technical report writing.	100% CA	Supplementary reading: Product Design and Development, by Karl Ulrich, Steven Eppinger
ME4101A	B.Eng. Dissertation	8	1 & 2 (across 2 semesters)	This core requirement course is a research- or design-based project to be conducted by a final year undergraduate student, as a demonstration of their level of mastery of Mechanical Engineering. Projects may be experimental, theoretical or numerical in nature; and may be multi-disciplinary. Through the project, students are introduced to the basic methodology of research in the context of a problem of interest, including surveying of available literature, design and execution of relevant experiments and analysis of results. Students will practise soft skills such as project planning and management, technical report writing and giving technical oral presentations.	On successful completion of this course, the student will be able to: (1) Undertake research projects in a methodological manner including literature search, formulation of problems, conduct experiments, and results analysis. (2) Think critically and learnt independently (3) Communicate effectively through technical report writing (4) Communicate effectively through technical oral presentations.	Stage 4 standing (112Units)	Nil	ME4101/ EG4301/ ME4101B	NA	100% CA	