NUS Mechanical Engineering
Core Modules

as at 1 Dec 2023

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 part 1 of a 2-course package – Engineering Principles and Practice - that introduces Year 1 students to what engineers do and the engineer's thought process. EPP I focuses on the engineering principles of how systems work and fail, and the engineering practice of how they are designed, built and valued. Given a practical engineering system, e.g. a drone, or an engineering event, e.g. the Challenger space shuttle disaster, students are guided to deconstruct the system into inter-connected sub-systems. Following which they will develop an understanding of how forces, energy flow and/or mass flow between sub-systems impact the whole.	EPP I and II contain three overarching learning outcomes: engineering skills, engineering principles and professional skills. Engineering skills define what engineers do, engineering principles define what engineers know and how they apply the relevant knowledge, and professional skills describe the most important non-technical skills that students should acquire at the end of Year 1. The desired learning outcomes are listed below. Engineering Skills: Learning Outcomes (ESLO) Engineering Principles: Learning Outcomes (EPLO) Professional Skills: Learning Outcomes (PSLO)	Nil	Nil	EG1111	System architecture and block diagrams Flow systems Forces, equilibrium and motion Loading of systems and components and impact of overloading System and component failure and design against such failure Engineering computation using spreadsheets and scripts Use statistical methods in experiments such as to estimate the accuracy of physical constants that are measured.	CA, Final Examination	**Supplementary reading:** Paul H. Wright, Introduction to Engineering Library, 3rd Edition ISBN: 978-0-470-62039-7, 288 pages. Sanjoy Mahajan, The Art of Insight in Science and Engineering and Mastering Complexity, MIT Press (free online) Street-fighting Mathematics: The Art of Educated Guessing and Opportunistic Problem Solving, MIT Press Beer and Johnston, Vector Mechanics for Engineers: Statics, McGraw Hill. Beer and Johnston, Vector Mechanics for Engineers: Dynamics, McGraw Hill. Beer and Johnston, Mechanics of Materials, McGraw Hill. Yunus Cengel, Introduction to Thermodynamics and Heat Transfer, McGraw Hill. White, F. M., Fluid Mechanics, McGraw-Hill
ME2104	Engineering Principles and Practice II	4	2	Part II of Engineering Principles and Practice will focus on the engineering principle of how systems are energized and controlled and the engineering practice of how they are designed, built and valued. Most modern engineering systems are powered electrically. They convert some raw form of energy such as fuel (petrol, diesel) or battery (electrochemically stored energy), into electrical energy. Hence energy sources and energy conversion, electrical energy utilization through conversion into various functions, measurement of functions through their performance parameters will form the backbone of this course.	EPP I and II contain three overarching learning outcomes: engineering skills, engineering principles and professional skills. Engineering skills define what engineers do, engineering principles define what engineers know and how they apply the relevant knowledge, and professional skills describe the most important non-technical skills that students should acquire at the end of Year 1. The desired learning outcomes are listed below. Engineering Skills: Learning Outcomes (ESLO) Engineering Principles: Learning Outcomes (EPLO) Professional Skills: Learning Outcomes (PSLO)	Nil	Nil	EG1112	Topics ● Energy sources and energy conversion ● Electrical energy distribution in a system ● Electrical energy utilization through conversion into various functions: motion, sound, light, etc. ● Loss, heat, temperature and efficiency ● Measurement of functions through their performance parameters ● Feedback and decision making	CA, Final Examination	**Supplementary reading:** Paul H. Wright, Introduction to Engineering Library, 3rd Edition ISBN: 978-0-470-62039-7, 288 pages. Sanjoy Mahajan, The Art of Insight in Science and Engineering and Mastering Complexity, MIT Press (free online) Street-fighting Mathematics: The Art of Educated Guessing and Opportunistic Problem Solving, MIT Press Giorgio Rizzoni, Principles and Applications of Electrical Engineering. Page 144 of 144 of 144 Allan R. Hambley, Electrical Engineering: Principles and Applications.
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. Have acquired the basic knowledge in engineering drawing principles, tolerance, engineering conventions and representations. 2. Be able to use advanced 3D modeling software in solid modeling. 3. Be able to do calculations on design components	Nil	Nil	ME2101 & ME2103	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	**Compulsory reading:** K.S.Lee, "Introduction to 3D Solid Modeling with SolidWorks (Third edition)", McGraw-Hill Education (Asia), 2008. "Shigley's Mechanical Engineering Design" by Richard G Budynas and J Keith Nisbett (10th edition in SI units) ISBN 978-981-4595-28-5 McGraw Hill **Supplementary reading:** A.W. Boundy, "Engineering Drawing" Third edition, McGraw Hill, 2007. Pickup and Parker, "Engineering Drawing with Worked examples. Vol. I & II", Third edition, Hutchinson & Co. Ltd, 1985. Cecil Jansen, Jay D. Helsel & Dennis R. Short, "Engineering Drawing and Design", 6 edition, McGraw Hill, 2002 Frederick E. Giesecke, Alva Mitchell et. al., "Principles of Engineering Graphics", second edition, Macmillan Publishing Company, 1994. William P. Spence, "Engineering Graphics", Prentice Hall, 1984.
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 the concepts of statics, equilibrium of a rigid body, forces and moments. 2. Understand frames and machines in a structural component. 3. Understand and analyze two dimensional stress system. 4. Understand and analyze beam deflection. 5. Understand and analyze stresses in a loaded beam. 6. Understand and analyze torsion of a circular bar.	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, Final Examination	• C. Ugural, Mechanics of Materials, McGraw-Hill, Current edition • R. C. Hibbeler,Mechanics of Materials, Prentice Hall, SI 2nd Ed., 2005. • F. P. Beer, E. R. Johnston, Jr. and J. T. DeWolf, Mechanics of Materials, McGraw-Hiil, SI 3rd Ed., 2004. • J. M. Gere and S. P. Timoshenko, Mechanics of Materials, PWS Publishing Company, 4th ed., 1997. • R. R. Craig, Jr., Mechanics of Materials, McGraw-Hill, 2nd ed., 2000.
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 and kinetics of rigid body motion. 2. Apply the knowledge of dynamics to solve mechanical vibration problems. 3. Apply the knowledge of kinematics and kinetics to the analysis of machines and mechanisms.	Cohort AY18/19 & before = PC1431 Cohort AY19/20 & after =ME1102	Nil	ME3112	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, Final Examination	**Compulsory reading:** Beer, Johnston and Clausen, "Vector mechanics for Engineers - dynamics", McGraw-Hill. **Supplementary reading:** J.L. Meriam and L.G. Kraige, "Engineering Mechaics, Vol 2, Dynamics", John Wiley & Sons. R.C. Hibbler, "Engineering Mechanics, Dynamics", Prentice Hall.
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. Analyze processes involving non-reacting gaseous and gas-vapour mixtures.	Cohort AY18/19 & before = PC1431 Cohort AY19/20 & after =ME1102	Nil	Nil	Properties of pure substances, steam tables and ideal gases (5 hrs) First Law of Thermodynamics: First Law applied to non-flow, flow processes and cycles. Ideal gas and condensible substances. (4 hrs) Second Law of Thermodynamics: Direct and reversed heat engines. Reversibility, processes and cycles. Carnot cycle. Clausius inequality. Absolute temperature. Entropy of substances. (5 hrs) 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. (4 hrs) Power and refrigeration cycles: Water as working fluid for power cycles. Rankine cycle, superheating and reheating. Vapour compression cycle. (6 hrs) Air standard cycles: Analysis of Otto, Diesel and Mixed cycles. Gas turbine cycle. (6 hrs) Convection & radiation heat transfer: Convective heat transfer coefficient. Non-dimensional groups in convection. Convective boundary condition. Overall heat transfer coefficient. Introduction to radiation. (6 hrs)	Lab, Test, Final Examination	**Compulsory reading:** Cengel Y.A. and Boles, M.A., "Thermodynamics: an engineering approach", 6th edition in S.I. units, McGraw-Hill Book Company, 2007. **Supplementary reading:** Van Wylen, G.J. and Sonntag, R.E., "Fundamentals of Classical Thermodynamics", 6th edition, John Wiley & Sons, Inc, 2003. Rogers, G.F.C. and Mayhew, Y.R., "Engineering Thermodynamics", 4th edition, Longman Group Ltd, 1992. Jones, J. B. and Dugan, R.E., "Engineering Thermodynamics", Prentice-Hall International, Inc., 1996.

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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 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. This course ends with an introduction to pumps, their elementary theory and matching pump and system.	On successful completion of this course, the student will be able to: 1. classify different types of fluid, identify different types of flow regimes, define stress and rate of strain in a fluid, and understand the phenomenon of surface tension. 2. analyze hydrostatic forces on submerged plane or curved surfaces, evaluate stability of floating bodies and identify the states of equilibrium of floating bodies. 3. define streamlines and establish energy equation and derive Bernoulli equation from it. 4. analyze equilibrium of moving fluid in translation and rotation, and apply continuity, linear and angular momentum equations to analyze fluid mechanics problems. 5. formulate dimensional groups using Rayleigh techniques and Buckingham Pi Theorem, and analyze fluid mechanics problems using the concept of modelling and similitude. 6. analyze energy loss and velocity distribution for laminar flow and turbulent flow in smooth and rough pipes, and apply Moody chart and minor losses in 7.classify different types of pumps, and analyze matching pump and system characteristics.	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. 7. An Introduction to Pumps: Classification of pumps, elementary pump theory, and analysis of matching pump and system characteristics	Lab reports/Assignment, Final Examination	**Compulsory reading:** 1. "Fluid Mechanics" by F.M. White, 7th edition (McGraw Hill) 2011. 2. "Fundamentals of Fluid Mechanics" by B. R. Munson, D. F. Young, T. H. Okiishi & W. W. Huebsch,, John Wiley & Sons, Inc., 7th Edition, 2013. **Supplementary reading:** 3. "Introduction to Fluid Mechanics" by R. W. Fox, A. T. McDonald & P. J. Pritchard, John Wiley & Sons, 8th Edition, 2012. 4. "Fluid Mechanics: Fundamentals and Applications" by Y. A. Cengel and J. M. Cimbala, Mcgraw-Hill, 3rd Edition, 2014. 5. "Mechanics of Fluids" by M. C. Potter, D. C. Wiggert & M. Hondzo, Prentice Hall, 4th Edition, 2012. 6. "A Physical Introduction to Fluid Mechanics" by A. J. Smits, John Wiley & Sons, 1st Edition, 2000. 7. "Mechanics of Fluids" by I. H. Shames, McGraw-Hill, 4th Edition, 2003. 8. "Engineering Fluid Mechanics" by C. T. Crowe, D. F. Elger, J. A. Roberson & B. C. Williams, John Wiley & Sons, 9th Edition, 2010. 9. "Fluid Mechanics" by J. F. Douglas, J. M. Gasiorek, J. A. Swaffield & L. B. Jack, Prentice Hall, 5th Edition, 2005. 10. "Fluid Mechanics with Engineering Applications" by J. B. Franzini & E. J. Finnemore, McGraw-Hill, 10th Edition, 2002. 11. "Mechanics of Fluids" by B. S. Massey, Taylor & Francis, 9th Edition, 2012. 12. "Applied Fluid Mechanics" by R. L. Mott, Prentice Hall, 6th Edition, 2006. 13. "Elementary Fluid Mechanics" by R. L. Street, G. Z. Watters & J. K. Vennard, John Wiley & Sons, 7th Edition, 1996. 14. "Fluid Mechanics" by V. L. Streeter, E. B. Wylie & K. W. Bedford, McGraw-Hill, 9th Edition, 1997
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	Nil	ME2142E, EE2010 and EE2010E	**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	1. Course Notes. 2. R.C.Dorf and R.H. Bishop, "Modern Control Systems," Prentice Hall Inc., 2008 3. K. Ogata, "Modern Control Engineering," Prentice-Hall, Inc., 2002. 4. B.C. Kuo, "Automatic Control Systems," Prentice Hall, Inc., 1995
ME2162 (previously known as ME3162)	Manufacturing Processes	4	1 & 2	Manufacturing processes: cold and hot working, rolling, extrusion, forgoing, sheet and metal blanking and forming, cold forming, welding, brazing, soldering, casting, powder metallurgy, plastics technology. Machine tools: RP, 3-D printing, Lathes, Milling, Drill press, Grinding and laser machining, etc.	On successful completion of this course, the student will be able to: 1. The student will know the principles and applications of various manufacturing processes, and be able to compare them 2. The student will know the principles and applications of plastics manufacture 3. The student will know the principles and applications of metal machining	Nil	Nil	ME3162	A) Manufacturing processes: • Introduction to cold and hot working. • Rolling - 2, 3 and 4-high rolls, cluster and planetary rolls, manufacture of blooms, billets and slabs. • Extrusion - Direct and indirect extrusion, hollow extrusion, hydrostatic extrusion. • Forging - Hammer, press, roll forging, open and closed die forging. • Sheet metal bending and deep-drawing, punch load, drawability, Crane's constants. • Shearing of sheet metal - types of shearing operation, punch and die clearance, punch force. • Cold forming processes - Marforming, Guerin process, hydroforming. • Welding, brazing, soldering - Arc and gas welding, pressure welding, MIG, TIG, submerged-arc, friction, resistance, laser and electron-beam welding. • Casting - Sand casting, patterns, defects, die-casting, centrifugal casting, investment casting, continuous casting. • Powder metallurgy - Production of powders, fabrication processes, sintering, comparison with other processes. • Electro-discharge machining. • Plastics technology - Properties of plastics, thermoplastics and thermosets, manufacturing of plastics B) Machine tools: • Introduction to machine tools and machining operations, Saws (band, abrasive and toothed circular), Drill presses, Lathes, Milling machines and machining centres, Grinders, Single point, multi-point and abrasive material removal Generating motions of machine tools • Cutting tool materials Major tool material types. • Introduction to rapid prototyping Additive manufacturing technologies (fused filament deposition, photo-curing, powder fusing/binding, polymer jetting) • Introduction to laser cutting Laser cutting of sheet material (metal and polymer)	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) (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) Working 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 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	ME3103 & ME4101A	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	Compulsory reading: Courseware on Luminus. Supplementary reading: Product Design and Development， McGraw-Hill/Irwin, 2nd Ed., by Karl Ulrich, Steven Eppinger, Oct. 1999.
ME4101A	B.Eng. Dissertation	8	1 & 2 (across 2 semesters)	This course consists mainly of an industrial or research-based project carried out under the supervision of one or more faculty members. It introduces students to the basic methodology of research in the context of a problem of current research interest. The course is normally taken over two consecutive semesters, and is a core requirement of the B.Eng. (Mech) program.	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 analysis. (2) Think critically and acquire independent research skills that are vital for life life-long learning. (3) Communicate effectively through technical report writing on the achievements of the final year project. (4) Achieve confidence in communication skills through various project oral presentations.	Stage 4 standing (112Units)	Nil	ME4101/ EG4301	NA	100% CA	Dependent on project selected.
ME4102	Standards in Mechanical Engineering	4	1 & 2	Standards provide requirements, specifications, guidelines or characteristics that can be used	1. Able to identify and describe some of the standards in the field of mechanical engineering, both	Nil	Nil	Nil	In this course, we understand that the standards in mechanical engineering cover a wide range, they include but not limited to the following three categories, namely smart manufacturing, sustainable	100% CA	**Compulsory reading:** • Lecture Notes
ME4103	Mechanical Engineering and Society	4	1 & 2	Part 1 – Introduction to Project Management In addition to leadership, motivation and communications skills, Project Management involves task planning, cost estimation, measuring and controlling the execution of tasks. Through a combination of lectures, seminars, case studies/tutorials, students will be introduced to the relevant quantitative processes and tools of project managements. Part 2 – Humanitarian Engineering To understand the roles of engineers in advancing the society, student will first be introduced to Professional Engineering Societies to understand how they help them advance their careers. Students will then work on a group project to address one of the grand challenges in Humanitarian Engineering.	Part 1 (1) Able to describe the nature of project management and its related activities, i.e., planning, estimating, project life cycle, management roles, project authority, etc. (2) Able to plan the execution of a project through exercises and seminar using some typical project management software, e.g., Microsoft Project, etc. Part 2 (3) Able to to explain the roles of engineers in advancing society (4) Able to describe grand challenges in engineering, specifically in humanitarian engineering (5) Able to design engineering systems taking into considerations the non-technical factors from humanitarian point of view.	Nil	Nil	Nil	Part 1 – Introduction to Project Management • Understanding the nature of the projects • Project Management Process • Role of project manager • Effective Planning • Estimating • Preparing a Project Plan • Project Life Cycle • Planning Tools • Management Roles • Reviewing and Reporting Process • Project Authority • Effective Delegation Part 2 – Humanitarian Engineering • Reviews on the roles of engineer in advancing the society. • Discussions on the Grand Challenges for engineers, specifically in humanitarian engineering. • Writing an effective engineering project proposal.	100% CA	N.A.