COURSE SYNOPSIS

CORE COURSES

SEMM 1013 - Programming for Engineers

This course formally introduces the concept of computers, algorithms, programming languages, pseudo-code, and design of programs for solution to computational engineering problems. The two programming languages introduced in this course are C and MATLAB. Topics covered in this course include data types, constants, variables, arithmetic operations, assignment statement, looping, formatted I/O, functions, arrays, matrix operations, data structures, plotting and model building.

SEMM 1113 - Mechanics of Solids I

The course provides students with the knowledge to determine the strength and stiffness of engineering structures being used. The structures that will be used in this course are bars, pins, bolts, shafts and beams and the types of applied loadings are axial forces, deformations due to the change in temperature, torsional loads, transverse loads and combination of these loads. At the end of the course, students should be able to determine the mechanical properties of the materials with respect to their strength and stiffness. Students should be able to calculate stresses, strains and deformations in structures due to various types of loading conditions. In addition, they should be able to solve problems related to statically determinate and indeterminate structures.

SEMM 1203 - Statics

This course introduces students to the part of mechanic which is a pre-requisite for most engineering courses including SEMM 1213, SEMM 2313 and SEMM 1113. The course enables student to acquire the essential basic knowledge of resultant and equilibrium of forces. It will examine key elements in producing free body diagrams for particles and rigid bodies, as essential first step in solving applied mechanics problems. Exposure to the conceptof moment and equilibrium equations with reference of Newton's Law enhances the relevance of friction, trusses, frames and machines applications. Students are also introduced to the concept of distributed forces, which include centroid and centre of gravity and the generated surface area and volume of revolution. Hence, students will be able to demonstrate and applythe knowledge in continuing subjects which requires the analytical skills developed in this subject.

SEMM 1213 - Dynamics

The course is an extension to SEMM 1203, which is the pre-requisite to this course. It introduces students to the part of mechanics which considers the action of forces in producing motion. This course provides an exposure to students on the theory of the kinetics and kinematics of particles and rigid bodies. The concepts of energy, work, momentum and impulse are also introduced. At the end of the course students should be able to apply the principles to study and analyse the behaviour and responses of dynamical systems. They should also be able to solve the dynamic problems related to the determination of forces energy and power to move a body.

SEMM 1503 - Engineering Drawing

This subject introduces student to the use of technical drawing in an effective way for communicating and integrating with engineering concepts. Such environment will provide a platform where the engineer can share and exchange information. This subject will also enlighten the student on the significant changes in the engineering and technical graphic dueto the use of computer and CAD (Computer Aided Design) software. At the end of the course,student should be able to apply the skill and knowledge of engineering drawing to interpret design, using graphics method such as geometric drawing, orthographic projection, isometric,machine drawing, detailed drawing, and basic CAD software.

SEMM 1513 - Introduction to Design

This course is designed to introduce students to the concepts and methods of engineering design process in solving engineering design problems, creatively and effectively. The design process introduces problem background, concept generations and selections, development of selected concept and testing of selected concept by constructing and testing a prototype. This course serves as a preparation for students to proceed to higher level design classes.

SEMM 1911 - Experimental Methods

This course is conducted via lectures and experimental case study data. Students are exposed to the experimental method theory for the initial weeks and then followed by case study data. The lecture contents shall cover the fundamental of experimental method and the basic principles in measurements, instrumentation and analysis of results. It shall focus on the design of mechanical experiments, selection of sensors and transducers, estimation of errorsand display of results. It shall also cover the analysis of results and how to prepare proper report writing. Student comprehension will be tested in two written tests. Based on the given experimental data, students are also expected to conduct statistical analysis of results and write the experimental outcome in a report.

SEMM 1921 - Introduction to Mechanical Engineering

This course comprises of two modules intended to introduce students to the field of mechanical engineering. The first module raises the student's awareness to the importance and necessity of developing habits of systematic analysis in solving engineering problems. It introduces the UTM graduate attributes and highlights the importance of generic skills to engineers. It also provides students with a clear overview of different fields within MechanicalEngineering and a description of the mechanical engineer's work and professional responsibilities. It discusses the education requirements for today's mechanical engineers aswell as exposes the students to the skill required for an engineer entrepreneur. This course introduces students to the field of mechanical engineering. It raises the student's awareness to the importance and necessity of developing habits of systematic analysis in solving engineering problems. It introduces the UTM graduate attributes and highlights the importanceof both technical and generic skills to mechanical engineers. It also provides students with a clear overview of different fields within mechanical engineering and a description of the mechanical engineer's work and professional responsibilities. It discusses the education requirements for today's mechanical engineers as well as exposes the students to the skills required for an engineering entrepreneur.

SEMM 2123 - Mechanics of Solids II

The course is an extension to SEMM 1113, which is the pre-requisite to this course. It aims to extend the student's knowledge and understanding of the behaviour of materials and structures under a variety of loading conditions. The course starts off with plane stress and plane strain transformation, following which several elastic failures criteria's are investigated.The course provides an opportunity to investigate thick cylinders, structural deformation behaviour by using the energy method, instability problems of struts and elasto-plastic bending of beams. Determinate and indeterminate problems will be examined. At the end of the course,students should be able to calculate and evaluate stress, strain and deformation of structuresin torsion and bending. They should also be able to evaluate failure modes and estimate fracture life of structures and components. The aspect of designing safe components and structures shall also be emphasized to the students.

SEMM 2223 - Mechanics of Machines and Vibration

The course requires SEMM 1213 as the pre-requisite. It is designed to expose students to the application of concepts in mechanics (statics and dynamics) to solve real world mechanical engineering problems pertaining to various machines which include belt and pulley systems, gears, flywheels, governors and gyroscopes. Students will also be exposed to the methods of balancing rotating masses and parts of a combustion engine. The concept of vibration with respect to one-degree-freedom is also studied. At the end of the course, the students should be able to solve problems related to various mechanical systems. In addition, they should be able to evaluate analytically the parameters of components of various machines under study.

SEMM 2313 - Mechanics of Fluids I

The principle aim of this course is to provide students with an understanding of the properties of fluids and to introduce fundamental laws and description of fluid behaviour and flow. It will emphasize on the concept of pressure, hydrostatic pressure equation and its application in the measurement of pressure, static force due to immersed surfaces, floatation and buoyancyanalysis. Dynamic flow analysis inclusive of technique in solving flow problems is introduced especially to solve flow measurement, mass or volumetric flow rate, momentum in flow and loss in pipe network. Lastly, some basic dimensional analysis and similarities will be introduced. At the end of the course, the student should be able to demonstrate an ability to analyse whether statically, dynamically or kinematically problems related directly to fluids.

SEMM 2323 - Mechanics of Fluids II

This course is designed to enhance the basic knowledge that has been developed in the first stage of Fluid Mechanics and expose the students in analysing hydrodynamically the flow field. It will emphasize on the analysis and the importance of ideal, boundary layer, and compressible flow in a practical engineering application. The course will also provide the analysis of flow through fluid machines such as pump and turbine. At the end of the course, students should be able to demonstrate and apply the theory to solve problem related to flowof fluids.

SEMM 2413 - Thermodynamics

Thermodynamics is a basic science that deals with energy. This course introduces students to the basic principles of thermodynamics. It will discuss basic concepts and introduces the various forms of energy and energy transfer as well as properties of pure substances. A general relation for the conservation of energy principle expressed in the First Law of Thermodynamics will be developed and applied to closed systems and extended to open systems. The second law of thermodynamics will be introduced and applied to cycles, cyclic devices and processes.

SEMM 2433 - Applied Thermodynamics & Heat Transfer

This course aims to develop a fundamental understanding of the processes by which heat and energy are inter-related and converted and by which heat is transferred. The course will review major principles of energy conversion and the modes of heat transfer. The basic laws of thermodynamics and the governing equations for heat transfer and thermodynamics will be introduced and subsequently used to solve practical engineering problems involving thermodynamics and heat transfer. The course will also cover fundamental principles of powergeneration systems.

SEMM 2613 - Materials Science

This course introduces students to the fundamentals of materials science and engineering with emphasis on atomic bonding, crystal structures and defects in metals. It will introduce students to the various classes of materials including metals, ceramics, polymers and composites and their fundamental structures. The course will also provide basic diffusion mechanisms, metal solidification phase diagrams and heat treatment processes. At the end of the course, students should be able to apply the knowledge of atomic bonding and crystal structures to predict the physical and mechanical behaviour of materials and use the principlesof phase diagrams and heat treatments to the design of materials and their properties.

SEMM 2713 - Manufacturing Processes

This course discusses the fundamental aspect of various traditional and non-traditional manufacturing processes for metal and non-metal components. It starts from the overall introduction on manufacturing aspects followed by polymer shaping processes, castingprocesses, joining processes, metal forming processes and machining processes including CNC and CAM. At the end of this course, the students should be able to select suitable manufacturing processes to produce a part/product. The knowledge gained from this course also allows students to make right decision in designing products based on process requirements.

SEMM 2921 - Laboratory I

This course is introduced in the second year of the Mechanical Engineering programme involving two hours per week session and experimental based courses. It consists of six laboratories; Strengths of Materials Laboratory, Materials Science Laboratory, Mechanics of Machines Laboratory, Electrical Laboratory and Fluid Laboratory. Students will be grouped into 5 to 6 people for each experiment. It is based on the theory that have been learned in theparticular courses at the same semester. In general, every student has to carry out a total of twelve experiments. At the end of the session, students have to submit a report for each

experiment and will be evaluated based on this report.

SEMM 3023 - Applied Numerical Methods
This course formally introduces the steps involved in engineering analysis (mathematical modelling, solving the governing equation, and interpretation of the results). Examples of casestudies in applied mechanics, strength of materials, thermal science, and fluid mechanics arepresented. Methods for solving the nonlinear equations, simultaneous linear algebraic equations, eigenvalue problem, interpolation, numerical differentiation, numerical integration,initial value problems, boundary value problem and partial differential equation are introduced.

SEMM 3233 - Control Engineering
The course shall cover the essential and basic theory of control engineering. It shall cover the followings: open and closed-loop systems, manipulation of block diagram, signal flow graph and Mason's rule, concept of transfer function, time response analysis, classification of system, control action, stability analysis, Routh criteria, root locus method, frequency analysis, Nyquist and Bode plots, relative stability from Nyquist and Bode diagrams and design of control system. MATLAB and Simulink software package shall be taught and used as a tool in solving control engineering problems where appropriate.

SEMM 3242 - Instrumentation
The course shall cover the essential and basic theory of instrumentation for undergraduate. It shall cover the following: fundamentals and components of instrumentation system, characteristics of instrumentation system, signal conditioning and application of sensors in measurements.

SEMM 3523 - Components Design
This course is designed to expose students in analysing machine design element failure theories. This includes failure due to static and fatigue loads. It involves fatigue strength and endurance level, modified stress Goodman diagram and fatigue design under tensile and combined stresses. The content will encompass the design and selection of bolts, welding, spring, ball and roller bearing, gears and belts. At the end of the course, students should havethe capabilities to identify, analyse and design the machine elements in the perspective of static and fatigue failure aspect.

SEMM 3813 - Industrial Engineering
This course introduces students to various theories, principles and the importance in the area of industrial engineering and project management. It covers issues related to productivity, quality, work study, ergonomics, facilities planning and project scheduling. The contents give some brief exposure on the concept and application of overall discipline for an industrial engineer. Some calculations or measurements are introduced as an approach before deciding the best alternative. Students should be able to describe fundamental aspects of project management and integrate knowledge in engineering and project management. In project management, students are exposed to several steps in developing project plan, managing risks, scheduling resources reducing project duration, and progress and performance measurement. At the end of the course, students should be able to apply various concept andtools in selecting the best alternative in terms of man, machine, materials, method and

management and planning and monitoring engineering projects.

SEMM 3823 - Engineering Management, Safety and Economics
This course aims to prepare students with basic management knowledge, safety and engineering economy. The management part will examine key issues in management and organization, past management and today, strategic management, organizational structure and design, human resource management, motivating employees and leadership. Major topics covered under safety are OSHA 1994, Factories and Machinery Act 1967, hazard identification, risk assessment and control, basic principles of accident prevention and occupational health. In engineering economy, students are exposed to engineering economicprinciples and methods of engineering economic analysis. At the end of the course, studentsshould be able to describe fundamental aspects of management; integrate knowledge in engineering and management in making business decisions; apply the principles of hazard identification, risk assessment/control; plan, design and implement an effective safety program; and also perform engineering economic analysis to solve problems and evaluate engineering investment/projects.

SEMM 3915 - Industrial Training
Industrial training exposes students to the real work setting in various industries for 12 weeks. The students are placed in industries that best suit their area of studies. It is an experiential learning that requires the students to learn the process and able to apply their knowledge acquired in class in actual industrial setting. The knowledge acquired during practical training may be used later in final year classes as well as to equip them with sufficient knowledge for job interviews.

SEMM 3931 - Laboratory II
This course is introduced in the third year of Mechanical Engineering programme involving two hours per week and experimental based courses. It consists of six laboratories; Strength of Materials Laboratory, Thermodynamics Laboratory, Materials Science Laboratory, Mechanics of Machines Laboratory, Electrical Laboratory and Fluids Laboratory. Students will be grouped into 5 to 6 for each experiment. It is based on the theory learned in the particular courses at the same semester. In general, every student has to carry out a total of twelve experiments. At the end of the session, students have to submit a report for each experiment and will be evaluated based on this report.

SEMM 3941 - Laboratory III
This course is introduced in the third year of the Mechanical Engineering programme involving two hours per week session and experimental based courses. It is divided into two parts; experimental work at System & Control and Vibration Laboratories and a problem- based- learning (PBL) laboratory (module) depending on the topics/labs facilitated by a lecturer. Students have to produce a short report for the experimental work similar to those in Laboratory I and II. The second part, i.e., the lab module is based on the PBL concept. Students have to plan and design their own experimental work right from the very beginning until the end of the module based on the topics given by the lecturer. Students will be groupedinto 5 to 6 for each module. In general, every group have to conduct two experimental works and two modules. At the end of the session, students have to submit two short reports and

two formal reports.

SEMM 4533 - System Design
This course is designed for students to gain detailed topical exposure to design methodologies and principles specific to the practice of mechanical design. Emphasis is on developing efficient and effective design techniques as well as project-oriented skills from both technical and non-technical considerations. At the end of this course, students should be able to identifyand apply appropriate methodologies in performing design tasks, recognize the fundamental principles of mechanical designs and practices, formulate and apply general problem-solvingstrategies in the analysis of situations and potential problems and apply relevant industry standards in design. Student should also be able to communicate ideas and solutions in verbaland written forms by means of oral presentation and technical report.

SEMM 4902 - Engineering Professional Practice
This course introduces students to engineering ethics and an engineer's responsibilities towards safety, health and welfare of the public. It emphasizes on the engineer as aprofessional man, engineers & society, code of ethics and professional conduct, standards, laws and regulations pertaining to professional engineering practice. The course will also introduce students to organize, in a group, community service activities in a planned and structured manner. At the end of the course, students should be able to demonstrate and applyengineering professional ethics in their career as an engineer.

SEMM 4912 - Undergraduate Project I
This course introduces the final year students on how to do academic research on their own by applying knowledge and skills they acquired from other courses. Given a topic on a project, students have to identify a problem, gather relevant information to the problem and propose solutions to problems. In this course, students have to do some literature surveys in order to understand the nature of the problem and investigate work done by other researchers in line with their work. The students are also required to propose a methodology on how to solve the problems. By the end of this course, the students are expected to submit and present their research proposal to be assessed by their supervisors and panel of assessors.

SEMM 4924 - Undergraduate Project II
This course is the continuation of Undergraduate Project (UGP) I. It enhances the students' knowledge and ability to identify and solve problems through academic research. It will provide an exercise for the student in carrying out research with minimum supervision and the ability to plan and manage their work effectively. This course will also develop the students' capability to present, discuss and analyse results of the research clearly, effectively and confidently in both oral presentation and in dissertation.

SEMB 3613 - Physical Metallurgy
The course introduces the student to the basics of materials crystal structures and stereographic projection. It also provides students with knowledge of atom diffusion in solids,phase diagrams and phase transformation. The course will provide detailed knowledge on steels using the Fe-C phase diagram and various heat treatments and the effect on mechanical properties. At the end of the course students should be able to apply knowledge

acquired on phase diagrams and atomic diffusion to read, construct and predict the materials structure and mechanical properties and design suitable heat treatments that would give the optimum performance through the use of the interrelationship between microstructure- mechanical properties and processes.

SEMB 3623 - Mechanical Properties of Materials

This course introduces students to the fundamentals of dislocation theory and the role of these dislocations in predicting the metal's ability to deform plastically. It will focus on the mechanical behavior of all classes of materials (metals, polymers, ceramics and composites) under different stressing conditions such as fatigue, creep, and fracture. The course will also providestudents with the principles of fracture mechanics and its application. The students also will be able to simulate and predict the mechanical behavior of materials using modern tools. At the end of the course the student should be able to link between the behaviour of materials and their structures and design procedures to control failure of materials.

SEMB 4613 - Materials Characterisation

This course will give an overview and the basic principles of the widely used materials characterisation techniques, namely, microstructure analysis using optical and electron microscopy, structure determination by x-ray diffraction and electron diffraction, chemical analysis by X-ray application, surface analysis by spectroscopy techniques and thermal analysis methods.

SEMB 4623 - Corrosion and Corrosion Control

This course introduces students to the basic principles of electrochemical and aqueous corrosion and oxidation of metals. The course will provide the principles that lead to metal corrosion and oxidation based on thermodynamics and Pourbaix diagrams, mixed potential theory and theory and application of passivity. The course will also provide knowledge on thevarious forms of corrosion and methods to control namely, by design, materials selection, cathodic protection, coatings and the use of inhibitors. At the end of the course students shouldbe able to apply the knowledge to determine whether corrosion will occur in any given environment and recognize the different types of corrosion as well as able to suggest a corrosion control system for protection against corrosive environment.

SEMB 4633 - Materials Selection in Mechanical Design

This course introduces students to the basic concepts of materials selection and provides systematic methodology for materials and process selection in engineering design. The course will emphasize on describing the relationship between component design and materials selection and how materials selection fits into the design process from concept to the final details. The interaction between the manufacturing process and material selection and the need to adopt concurrent engineering approach is described. The effect of environment and economic impact on materials and process selection is also introduced. The course providesstudents with case studies and project in which the methodology of materials and process selection utilizing computer and specialized software is used. By the end of the course students should be able to perform the necessary calculations, identify the design/functional requirements of materials properties and perform the selection of candidate materials.

ELECTIVE COURSES

SEMB 4643 - Non-Destructive Testing

This course aims to develop an understanding of the working principles associated with established and widely used techniques for non-destructive testing (NDT), specifically dye penetration, magnetic particle, eddy current, ultrasonic and radiography. Upon completion of this course, the students will be able to understand the working principle, needs and the technique to conduct the testing. This course will elaborate on the theory of each method, theprobes needed, the mechanism to detect either surface or subsurface defects, the propertiesof materials to be tested, the test methods involved and the advantages and disadvantages ofeach method.

SEMB 4653 - Surface Engineering

This course covers the aspects of surface engineering, to develop fundamental understanding and the role of materials to allow surface selection for mechanical contacts and their surrounding environmental conditions. The course will explore a range of surface treatments and advanced coatings that are designed to minimize wear, friction and surface oxidation / corrosion. Applications and economics of surface treatments/coatings will be addressed by means of industrial case studies. The lectures will draw on examples from applications withinthe marine, oil and gas, aerospace and biomedical sectors. Emphasis will be placed on gainingsustainability through correct surface engineering technology. The economics of surface selection will be discussed for various examples, e.g. subsea components, machine tool coatings and thermal barrier coatings for aerospace.

SEMB 4663 - Advanced and Functional Materials

This course introduces students to the recent developments on the various classes of advanced and functional materials used in applications such as aerospace, automotive, biomedical and electronic industries. It will emphasize on the important properties exhibited by metallic, polymeric, ceramics and composite materials that make them selected for high- end and advanced applications. The physical and mechanical properties of the various classesof advanced materials (super alloys, titanium and aluminium alloys, intermetallic, biomaterials, electronic and magnetic materials) will be detailed as well as the processing techniques associated with producing these materials. The course will also cover smart materials such as shape memory alloys, Solar cell materials, fuel cells, high density energy storage batteries, Green materials, Smart sensors and actuators. The students are enabled to describe structural setup and function of advanced and functional materials. They command modern synthesis techniques and are able to apply these techniques to the preparation of new compounds. The students can interpret and evaluate the results of various methods for structural analysis of functional materials and apply the knowledge to select suitable materialsfor a given engineering project.

SEMB 4673 - Materials Processing

This course introduces students to the manufacturing methods of engineering materials into the desired shapes. It starts with the basic concepts of manufacturing and processing and their applications to metals as it introduces students to solidification in casting, powder metallurgy, deformation processes. The course will examine the various processing methods

for metals, ceramics, polymers and composite materials, including joining and recycling processes for metals, polymer and ceramics. The course emphasis on the role played by materials and their properties in selecting the optimum manufacturing method. At the end of the course students should be able to demonstrate the ability to relate structure of materials to properties and processing method.

SEMB 4683 - Nanomaterials

This course introduces students to fundamental aspects of nanomaterials and nanotechnology. The importance of the nanoscale materials and their improved properties compare to conventional materials. The principles and relative merits of a range of techniquesfor the fabrication of nanostructures in one dimensional and two-dimensional materials including single atomic layer and multilayers are discussed. The analytical and imaging characterization techniques and the recent applications of nanomaterials in engineering suchas electronics, energy devices and biomaterials will be briefly discussed.

SEMB 4693 - Modelling in Materials Engineering

This course introduces students to the basic concepts of computer modelling in materials science and engineering. The course covers basic principle in establishing numerical simulation for the evaluation of material properties and phenomena during material processing. It will emphasize on atomistic, mesoscopic and microscopic evaluation of materialproperties and behaviour by computer simulations. In detail, molecular dynamic method will be given as an example of atomistic evaluation method, whereas discrete dislocation dynamics will be used for mesoscopic simulation method. For microscopic scale evaluation, phase-field method will be introduced as an example. At the end of the course students shouldbe able to construct simple numerical modelling both in atomistic, mesoscopic and microscopic scale.