

## **COURSE SYNOPSIS**

### **CORE COURSE**

#### **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 concept of 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 apply the 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 due to 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 errors and 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 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 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 importance of 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 failure 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 structures in 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 buoyancy analysis. 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 analyze 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 flow of 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 principles of 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, casting processes, 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 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 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 have the capabilities to identify, analyse and design the machine elements in the perspective of static and fatigue failure aspect.

### **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 case studies in applied mechanics, strength of materials, thermal science, and fluid mechanics are presented. 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 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 grouped into 5 to 6 for each module. In general, every group has 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 identify and apply appropriate methodologies in performing design tasks, recognize the fundamental principles of mechanical designs and practices, formulate and apply general problem-solving strategies in the analysis of situations and potential problems and apply relevant industry standards in design. Students should also be able to communicate ideas and solutions in verbal and 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 a professional 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 apply engineering 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 analyze results of the research clearly, effectively and confidently in both oral presentation and in dissertation.

### **SEMI 3813 - Work Design and Productivity**

This subject is designed to introduce students to techniques in designing work in manufacturing and service industries. It will emphasize on method study and work measurement. Other concepts and approach will also be introduced such as Productivity, Sustainability, Principles of Motion Economy, Design for Manufacture and Assembly (DFMA), Single Minute Exchange of Die (SMED) and Mistake Proofing (Poka Yoke). At the end of the course, students should be able to select the appropriate techniques, approaches and concepts in designing work that optimizes the use of resources such as man, machine, materials and time to improve productivity.

### **SEMI 3823 - Quality System**

This course emphasizes on the importance of quality and productivity in industrial and operation systems. The principles of quality Improvement strategies and quality management systems such as Total Quality Management, Six Sigma, Lean Sigma, ISO 9000, ISO 14000 are highlighted. Statistical process control (SPC) techniques such as seven basic tools, variable and attribute control charts, process capability studies, acceptance sampling and reliability are covered. Students are required to work in groups to integrate the quality and statistical engineering tools in solving case studies problems.

### **SEMI 3833 - Production Planning and Control**

This course is designed to expose students to the several theories and principles in Production Planning and Control (PPC) either in manufacturing or service sectors. It discusses issues on forecasting, capacity and aggregate planning, scheduling, inventory control and also computerized manufacturing system such as Manufacturing Requirement Planning (MRP), Demand Requirement Planning (DRP) and Enterprise Resources Planning (ERP). Besides that, it also introduces basic lean concept as part of the latest issues in manufacturing system. At the end of the course, students should be able to apply knowledge in production planning and control for managing all the resources such as man, machines, materials and time in an organization. This is to ensure the system becomes more productive, effective and efficient.

### **SEMI 3843 - Engineering Economy and Accounting**

This course is designed to equip students to acquire engineering economy and accounting concepts, principles and methods. The focus of this course is to provide understanding on engineering economic principles and methods and to apply it in engineering field. The course



has two parts. Part 1 is designed to teach students to formulate cash-flow, perform analysis on engineering economic problems and evaluate between alternative of engineering investment/projects to make decision. Part 2 is designed to teach students to perform cost estimates using traditional and current costing techniques in production process, prepare simple financial statement and interpret financial performance of business firms for decision and control.

#### **SEMI 4813 - Industrial System Simulation**

This course is aimed to equip students with the knowledge on discrete-event simulation. A software will be utilized to model, build and run simulation models. The course cover topics on discrete-event approaches, representing uncertainty, trace driven simulation, input data analytics, modelling and building simulation models, verifying and validating simulation models, experimentation and running of simulation models, analysis of output results, etc

#### **SEMI 4823 - Operation Research**

This course provides students with the concepts and tools to model manufacturing or service systems efficiently using mainly Operations Research techniques. It focuses on formulating models based on deterministic and stochastic Operations Research techniques, applying these techniques for decision making and developing solutions from the models.

#### **SEMI 4833 - Safety and Engineering Management**

This course aims to prepare students with basic management knowledge and safety. The management part touches key issues in management and organization, management yesterday and today, strategic management, organizational structure and design, human resource management, motivating employees and leadership. In addition to these, project management aspects are included such as developing a project plan, managing risk, scheduling resources and costs, reducing project duration, and Progress and Performance Measurement. Major topic covers for safety are OSHA 1994, Factories and Machinery Act 1967, hazard identification, risk assessment and control, basic principles of accident prevention and occupational health. For Project Management, students will be exposed with some methods of doing network for project such as CPM and PERT, lagging activities and how to calculate cost for crash project. At the end of the course, students should be able to describe fundamental aspects of management; integrate knowledge in engineering and management in making business decisions, managing a project using project management principles and techniques in planning, scheduling and controlling projects, and apply the principles of hazard identification, risk assessment/control; plan, design and implement an effective safety program.

#### **SEMI 4843 - Facility Design**

This course is designed to equip students with the basic knowledge of designing manufacturing layout facilities. Topics covered in this course include selection of the facility location, design layout procedures and algorithms, personnel requirements, line balancing, material handling and warehouse operations. At the end of the course, students should be able to design manufacturing plant layout by considering all engineering/manufacturing and supporting activities requirements, evaluate the best layout from the generated alternatives, select the best facility location, determine line balancing loss and select the best material



handling equipment for the manufacturing plant.

## **ELECTIVE COURSES**

### **SEMI 4853 - Quality Engineering**

This course covers process and product variation, Six Sigma, Quality Function Deployment, Failure Mode Effect Analysis, Gage Repeatability and Reproducibility, Short Run SPC and experimental methods such as Taguchi Methods and Classical Experimental Designs. Students are required to work in groups to integrate these tools in solving case studies problems.

### **SEMI 4863 - Ergonomics and Occupational Safety**

The course provides an introduction to ergonomics and occupational safety. In ergonomics, it concerns the study of human at work with the purpose of enhancing efficiency, productivity and comfort. It places human at the centre of reference with the components of machine, workspace and environment. In occupational safety, it introduces boiler, Unfired pressure vessel (UPV), hoisting machine and local exhaust ventilator (LEV) design. At the end of the course, students should be able to apply ergonomics and occupational safety principles and techniques in the design and analysis of workplace, processes and products.

### **SEMI 4873 - Reliability and Maintenance**

This course introduces the reliability and maintenance concepts and tools. It gives an understanding about how to apply these concepts and tools at different phases of systems' and component life cycle. It covers maintenance and reliability models and to assist the decision maker in making cost effective decisions based on life cycle costing. At the system/equipment utilisation phase, it focuses on understanding how maintenance can improve the availability of processes, and how to reduce downtime through maintenance optimisation and total productive maintenance.

### **SEMI 4883 - Supply Chain Management and Sustainability**

The course is designed for early exposure and understanding of the practical and theory in supply chain management and sustainability to the students. It guides students to develop an effective SCM strategy and its activities also the relationships that exist among a chain of firms that work together to provide a product or service. It shall cover the followings: Supply chain strategy, Sourcing strategy, logistic management, distribution management, measuring supply chain performance, information technology in supply chain, coordination in supply chain, and sustainability. The learning process for this course will be conducted through lectures, case studies practices, discussion, audio-video presentation, group project and presentation.