

## **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 mechanics 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 Profession**

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 failures criteria 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 specially 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 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 power generation 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 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 3033 - Finite Element Methods**

This course gives students an exposure to the theoretical basis of the finite element method and its implementation principles and introduces the use of general-purpose finite element software for solving real-life engineering problems.

### **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 3622 - Materials Technology**

This course introduces students to the basic concepts required to understand and describe the mechanical behaviour and failure mechanism of metals. It will emphasise on the concept of stress intensity factor and fracture mechanics to predict failure of materials and provide understanding on conditions under which fatigue, and creep occur. The course will also introduce students to the theory of electromechanical corrosion in metallic materials, estimate the corrosion rate and understand the methods to control and manage corrosion. By the end of the course, students should be able to apply the criteria of failure to the design of materials and conduct failure analysis of engineering components. This course also covers the properties, processing, and applications of non-metallic materials mainly polymer, ceramic and composite.

### **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 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 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, a community service activity 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). 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.

## **ELECTIVE COURSES**

### **SEMT 3132 - Aircraft Structures I**

The course will give the student an introduction to the various types of structural components used in aircraft, together with their functions and stress calculations under different types of loading. The lectures will include qualitative descriptions of methods of fabrication and provide a thorough introduction to quantitative methods of analysis. The first section covers the analysis of the statically determinate and indeterminate structure including the various type of truss analysis. Next section covers the analysis of the opened, closed and thin wall beam structure peculiar to aircraft, features discussion on the effect of the various types of load exerted and an introduction to structural idealization. Finally, this section also investigates the stress analysis of the multi-cell structures due to the acting loads and its design characteristics. It is a blended course that combines traditional teaching methods to Problem-Based Learning (PBL) approach based on real problems of aircraft structures.

### **SEMT 3212 - Flight Mechanics**

Flight mechanics is an important aspect in the design and operation of an aircraft. A flight mission can only be operated successfully and safely if proper efforts are given to this aspect. Therefore, in this course students will be equipped with the fundamental concept of aircraft performance calculation and static stability determination needed to analyse and design modern aircraft. Proper due shall be given to both aspects of performance and static stability. It is a blended course that combines traditional teaching methods to Problem-Based Learning (PBL) approach based on real problems in flight mechanics and industrial visit of related industries.

### **SEMT 3333 - Aerodynamics**

The course gives an introduction to aerodynamics with specific emphasis to aircraft aerodynamics. The purpose is to instil understanding of the principle of aerodynamics and to provide foundation of fundamental aerodynamics analysis. The contents include: Fluid flow equations (Continuity equation, Euler and Navier Stokes equations); Inviscid flow theory and Joukowski transformation; 2D aerofoil theory (Vortex law, Biot-Savart law, thin aerofoil theory, Fourier theory, thick and cambered aerofoil); Finite wing theory (Vortex system and horseshoe vortex, downwash and lift distribution); Viscous Flow Theory and Boundary Layer; Introduction to industrial aerodynamics (vehicles and buildings). It is a blended course that combines traditional teaching methods to Problem-Based Learning (PBL) approach based on real problems of aerodynamics.

### **SEMT 3423 - Aerospace Propulsion System**

An introduction to aircraft propulsion system including the historical background, review of thermodynamics and fluid mechanics; fundamental of gas dynamics; piston engines; shaft and thrust power; cycle analysis: air standard and cycle with friction; turbojet engine cycle; turbofan engine cycle; gas turbine engine components and their functions; compressor and turbine



velocity diagram analysis; turbine blades cooling techniques; gas turbine emissions; chemical rocket engines. It is a blended course that combines traditional teaching methods to Problem-Based Learning (PBL) approach based on real problems of aircraft propulsion system.

### **SEMT 3822 – Aviation Management**

This course covers basic management concepts such as Planning, Organizing, Leading and Controlling; Management of the aviation industry; the process of airworthiness; airport operations; aviation organizations and rules; safety, liability and security in aviation industries; main activities of the aircraft manufacturer, main activities of the airline industry. It is a blended course that combines traditional teaching methods to Problem-Based Learning (PBL) approach based on real problems in aviation and industrial visit of related industries.

### **SEMT 4143 - Aircraft Structures II**

This course gives students an understanding of the basic principles in the analysis of aircraft structural components and the determination of their strengths under the various operational loading conditions. It covers the areas of thin plate analysis, analysis of structural instability, introduction to the analysis of unidirectional composites, introduction to aeroelasticity and fatigue of aircraft structures. It is a blended course that combines traditional teaching methods to Problem-Based Learning (PBL) approach based on real problems of aircraft structures.

### **SEMT 4223 - Flight Dynamics and Control**

This course is about the dynamics behaviour of rigid body aircraft and the application of control system theory to design simple stability augmentation systems to more complex automatic flight control systems. This includes the application of modern multivariable control system design using state-space methods. Topics include axes system and notation, equation of motion of rigid body including translation, aircraft longitudinal and lateral dynamic stability, flying and handling qualities, stability augmentation and automatic flight control system, aerodynamics stability derivatives and multivariable state-space methods. It is a blended course that combines traditional teaching methods to Problem-Based Learning (PBL) approach based on real problems in aircraft dynamics and control, which also comprising The Fourth Industrial Revolution (IR 4.0) element.

### **SEMT 4253 - Aircraft Instrumentation and Avionics**

Aircraft Instrumentation and Avionics course provides the understanding of various basic instrument and electronics used in aircraft. The major topics cover includes an introduction to instrumentation system, component of instrumentation, air data, calibration equations, gyroscopes, indicators, signal conditioning, data acquisition system, transducers, Introduction to avionics, GPS application. The devices that will be thought are such as ADF, VOR, DME, LORAN C, ILS, RADAR Altimeter, GPS, and Primary RADAR. It is a blended course that combines traditional teaching methods to Problem-Based Learning (PBL) approach based on real problems in aircraft instrumentation and avionics, which also comprising The Fourth Industrial Revolution (IR 4.0) element.



**SEMT 4513 - Aircraft Design I**

The course will allow students to learn methodology and decision making in aircraft design process. This Integrated Design Project (IDP) offers a distinctive opportunity to use knowledge and skill from previous studies in aeronautics class to conduct a practical aircraft design project. Contents of learning include feasibility study, aircraft aerodynamics, aircraft performance & stability and component design.

**SEMT 4523 - Aircraft Design II**

This course gives students an exposure to the aircraft design process and methodology. Students are split into several groups to carry out aircraft components design and analyses. The progress of this Integrated Design Project (IDP) is closely monitored by the lecturers. Lectures are given to provide the student with information and guidance as project goes along. Group presentation and feedback from lecturers are regularly arranged for student evaluation and design improvement.

**SEMT 4813 - Aviation Economy**

This course aims to expose Aeronautical engineering students with fundamental elements of economics commonly used in engineering and aviation. The course begins by introducing key economic concepts such as the cash flow diagram and factors in engineering economy. These fundamental concepts are applied on various decision-making tools such as Net Present Value, Future Worth, Annual Worth, Rate of Return and Benefit/Cost Analysis to solve aviation economics related problems. It is a blended course that combines traditional teaching methods to Problem-Based Learning (PBL) approach based on real problems in aviation and industrial visit of related industries.