## POSTGRADUATE MODULE DESCRIPTIONS

(Please note that not all modules listed are necessary available in any one year.)

In the descriptions of modules given below, the workload for the modules is displayed in an A-B-C-D- E format where:
A – No. of lecture hours per week
B – No. of tutorial hours per week
C – No. of laboratory hours per week
D – No. of project/assignment hours per week
E – No. of hours for preparatory work per week

Pre-requisites indicate the base of knowledge on which the subject matter of a particular module will be built. Before taking a module, a student should complete any pre-requisite module(s) listed for that particular module. W here pre-requisites are specified, equivalent modules will also be accepted. If in doubt, students should consult the course instructor or academic advisors regarding acceptable equivalent modules.

**ME5001 Mechanical Engineering Project**
Module Credit: 8
Workload: 0-0-0-10-0
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross-Listing: Nil
This module involves supervised project over two semesters, on a topic approved by the Programme Manager of Department. The project work should relate to one of the areas of Mechanical Engineering: Applied Mechanics, Control & Mechatronics, Energy and Bio-Thermal Systems, Fluid Mechanics, Manufacturing and Materials.

**ME5103 Plates and Shells**
Modular Credits: 4
Workload: 3-0-0-3-4
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): CE5512
Cross Listing(s): Nil
Students learn to analyse the deformation and stresses developed in plates and shell structures under load. They are able to apply the fundamental concepts in solid mechanics to the analysis of these structures, model the structural problem using mathematical techniques and obtain solutions to deformation and stress distributions. Topics: Basic concepts of mechanics. Plate bending theory. Circular and rectangular plates. Elements of shell theory. Membrane and bending stresses in shells. Axis-symmetric shells with general meridian. This is an elective module and the target students are engineers engaged in structural analysis of mechanical components.

**ME5106 Engineering Acoustics**
Modular Credits: 4
Workload: 3-0-0-3-4
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil Cross Listing(s): Nil
Noise is recognised as a source of annoyance since antiquity. However, its economic impact due to work lost caused by noise-induced health hazard was not realised until recently. Common remedy of using barriers is frequently not the most cost-effective way of combating this and an understanding of the noise-producing mechanism and changing it to a quieter process is always preferred if applicable. This course will lead the students from the basic fundamentals of acoustics through various noise- producing mechanisms and finally control measures that can be applied to different circumstances. The emphasis will be on the physical picture rather than mathematical.

**ME5161 Optical Techniques in Experimental Stress Analysis**
Modular Credits: 4
Workload: 3-0-0.5-2-4.5
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
This is a basic module which aims at providing a good foundation and understanding of optical techniques for research and industrial applications. Newer optical methods such as holography, shearography and electronic speckle pattern interferometry (ESPI) developed for research and industrial use will be studied. Updated methods such as using laser and computer technology in moiré and photoelasticity will be treated. Such advances have brought optical techniques to a new dimension in measurement and non-destructive testing. It is targeted at students seeking to use optical techniques in research and development.

**ME5204 Air Conditioning and Building Automation**
Modular Credits: 4
Workload: 3-0-0-4-3
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
The purpose of this module is to introduce the various design aspects of generic air conditioning systems. Students will develop the competence to size and select the sub-components of a typical air conditioning plant to meet prescribed conditions. The topics of the course include: psychrometrics, heat load calculation, energy analysis of buildings, air conditioning systems for commercial and industrial applications, performance of refrigeration systems, cooling and dehumidifying coils, air and water distribution, sub-component selection and specification, building automation systems, energy management strategies.

**ME5205 Energy Engineering**
Modular Credits: 4
Workload: 3-0-0-3-4
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
The objective of this course is to approach the study of energy conversion systems from an overall thermo-economic perspective. Students will gain the ability to integrate the various energy related topics covered in the undergraduate programme to evaluate the performance and make economic decisions on energy systems. The module will cover the following topics: energy perspectives, energy sources, thermodynamic aspects of energy conversion systems, performance evaluation of energy systems, improvement of energy efficiency, energy management, environmental aspects of energy use, thermo-economics, future trends in energy conversion, introduction to energy policy issues.

**ME5207 Solar Energy Systems**
Modular Credits: 4
Workload: 3-0-0-3-4
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
The aim of this module is to develop awareness among students on the use of solar energy for low temperature applications. They will acquire expertise on several aspects of solar thermal system design including meteorological conditions, solar systems and components, potential applications, and economic evaluation. Students will be expected to undertake 2 to 4 projects to gain hands-on design experience. The topics included are: analysis of solar radiation, heat transfer in solar systems, solar energy collection devices, energy storage systems, economics, system simulation and optimization, photovoltaic applications.

**ME5301 Flow Systems Analysis**
Modular Credits: 4
Workload: 3-0.5-0-3-3.5
Pre-requisite(s): ME2134 Fluid Mechanics I and ME21355Fluid Mechanics II or equivalent (Applicable to undergraduate students only)
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
In this module students will learn to analyse fluid system under steady and unsteady operations. It covers the steady flow system analysis, transient flow system analysis, fluid power and control, flow characteristics of system components, computer applications in flow system analysis and pressure surge control. The module is naturally divided into ~~covers~~ two areas – external flows & internal flows. The former will cover aerodynamics around 2D and 3D lifting surfaces while the latter will deal with turbine blades in cascades and internal flows in various flow systems such as pipes, ducts and pressure equipment. This module further develops their knowledge on various aspects of fluid mechanics and aerodynamics covered in their undergraduate modules. There is a compulsory Term Paper project for this module. This module is intended for graduate students and engineers interested in the analysis of fluid systems in aeronautical and offshore engineering applications.

**ME5302 Computational Fluid Mechanics**
Modular Credits: 4
Workload: 3-0.5-0-4-3
Pre-requisite(s): ME2135 (Applicable to undergraduate students only)
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
This graduate level module introduces students to the application of numerical methods for solving incompressible fluid flow and convective heat transfer problems. Major topics covered include: review of theory of numerical discretisation/approximations numerical techniques for elliptic and parabolic PDEs; conservation form; finite-volume discretisation; boundary layer problems; solving Navier- Stokes equations in stream function-vorticity and primitive-variables formulations; SIMPLE/R and related procedures; Artificial Compressibility Method; Marker-Cell procedures; steady-state, transient and pseudo-transient methods/approaches. Knowledge in fluid dynamics and heat transfer is presumed. Theory is reinforced by mini-projects. The module is recommended for students who intend to pursue graduate research that requires the application of CFD.

**ME5303 Industrial Aerodynamics**
Modular Credits: 4
Workload: 3-0-0-3-4
Pre-requisite(s): ME4233 (Applicable to undergraduate students only) Co-requisite(s): Nil
Preclusion(s): Nil Cross Listing(s): Nil
In this module, students will learn to analyse wind loading on buildings under steady and unsteady wind conditions. It covers wind data, atmospheric boundary layer, atmospheric turbulence, static wind loading, dynamic wind loading, wind environment, and wind tunnel studies; also included is atmospheric dispersion. This module further develops students' knowledge on various aspects of fluid mechanics covered in their undergraduate modules. There is a compulsory Term Paper project for this module. This module is intended for graduate students and engineers interested in the analysis and design of buildings to withstand wind loading.

**ME5304 Experimental Fluid Mechanics**
Modular Credits: 4
Workload: 3-0.5-0-2-4.5
Pre-requisite(s): ME2135 Fluid Mechanics II (Applicable to undergraduate students only)
Co-requisite(s): Nil
Preclusion(s): ME4234
Cross Listing(s): Nil
This module teaches techniques and skills in carrying out fluid mechanics experiments and data analyses. Major topics include: Similitude and modeling; W ind tunnel design; Velocity measurement; Pressure measurement; Shear stress measurement; Volume flow rate measurement; W ind tunnel blockage correction; End plate configurations; Flow visualization; Signal analysis. This module is primarily targeted at graduate students who are conducting experimental fluid mechanics research and those who have interests in experimental fluid mechanics. This module is also appropriate for undergraduate students enrolled in the department's Aeronautical Engineering Specialization, especially those who are working on experimental fluid mechanics research for their final year projects.

**ME5305 Fundamentals of Aeroelasticity**
Modular Credits: 4
Workload: 3-0-0-2-5
Pre-requisite(s): ME2134 Fluid Mechanics I and ME2114 Mechanics of Materials II (Applicable to undergraduate students only)
Co-requisite(s): Nil
Preclusion(s): ME4235
Cross Listing(s): Nil
This is an introductory course on aeroelasticity as applied to aerospace specialization. Aeroelasticity is defined as the interactions of the deformable elastic structures in free airstream and the resulting aerodynamic force, which broadly falls under fluid-structure interaction. After introducing the basic terminology and a classification, the basics of statics and dynamics of fluid - structure interaction will be given. Topics covered include static aeroelasticity (divergence, control surface reversal), dynamic aeroelasticity (flutter, buffeting, and gust response), aeroservoelasticity (fluid-structure-control interaction), unsteady aerodynamics over lifting surfaces, and experimental methods for flutter prediction.

**ME5309 Jet and Rocket Propulsion**

Modular Credits: 4
Workload: 3-0.5-0-2-4.5
Pre-requisite(s): ME2134 Fluid Mechanics I or equivalent
Co-requisite(s):Nil
Preclusion(s):ME5308
Cross Listing(s): Nil

In this module, the graduate students will apply the fundamental principles of fluid mechanics and thermodynamics to jet and rocket propulsion. The emphasis of this course will be on thermodynamic cycles, the mechanics and thermodynamics of combustion, component and cycle analysis of jet engines, and the performance characteristics of chemical rockets. The detailed analysis of operating characteristics of turbojet, turbofan, turboprop, afterburning, and ramjet propulsion systems will be covered. The major focus will be placed towards the analysis and design of inlet, diffuser, combustor, compressor, turbine, and nozzle.

**ME5361 Advanced Computational Fluid Dynamics**

Modular Credits: 4
Workload: 3-0.5-0-4-3
Pre-requisite(s): ME4233 (Applicable to undergraduate students only) Co-requisite(s): Nil
Preclusion(s): Nil Cross Listing(s): Nil

This is an advanced module on computational fluid dynamics (CFD) at the graduate level. The module introduces some newly-developed numerical techniques for simulation of fluid flows as well as convective heat transfer problems. Major topics covered in this module include: high-order numerical approaches for solving boundary-layer and Navier-Stokes equations; boundary integral method for linear systems; upwind and Godunov-type schemes for compressible flow simulation; lattice Boltzmann method for incompressible flow simulation. There is a compulsory Term Paper project for this module. The module is recommended for research students and engineers who intend to do research project in the CFD area.

**ME5401/EE5101R Linear Systems**

Modular Credits: 4
Workload: 3-0-0-3-4
Pre-requisite(s): EE4302 or ME4246 (Applicable to undergraduate students only)
Co-requisite(s): Nil
Preclusion(s): MCH5201, EE5101
Cross Listing(s): EE5101

Linear system theory is the core of modern control approaches, such as optimal, robust, adaptive and multi-variable control. This module develops a solid understanding of the fundamentals of linear systems analysis and design using the state space approach. Topics covered include state space representation of systems; solution of state equations; stability analysis using Lyapunov methods; controllability and observability; linear state feedback design; asymptotic observer and compensator design, decoupling and servo control. This module is a must for higher degree students in control engineering, robotics or servo engineering. It is also very useful for those who are interested in signal processing and computer engineering.

**ME5402/EE5106R Advanced Robotics**

Modular Credits: 4
Workload: 3-0.5-0-2-5
Pre-requisite(s): ME4245; ME2142 or EE2010 (Applicable to undergraduate students only). EE5101 (Applicable to graduate students only)
Co-requisite(s): Nil
Preclusion(s): MCH5209, EE5106
Cross Listing(s): EE5106

The aim of the module is for students to develop an in depth understanding of the fundamentals of robotics at an advanced level. It is targeted towards graduate students interested in robotics research and development. The focus is on in depth treatments and wider coverage of advanced topics on (a) kinematics, (b) trajectory planning, (c) dynamics, and (d) control system design. At the end of this module, the student should have a good understanding of all the related topics of advanced robotics, and be able to derive the kinematics and dynamics of a given robot, plan appropriate path, and design advanced control systems.

**ME5403/EE5103R Computer Control Systems**

Modular Credits: 4
Workload: 3-0-0-3-4
Pre-requisite(s): EE2010 (Applicable to undergraduate students only) Co-requisite(s): Nil
Preclusion(s): MCH5103, TD5241, EE5103
Cross Listing(s): EE5103

The module aims to introduce the basic concepts and design methods of digital control schemes. Peripheral techniques for discrete-time control realization will also be discussed. At the end of this module, students would be able to design digital control algorithms and implement them effectively. They would also gain an appreciation of applicability and practical issues. The topics covered are: process modeling and identification; discrete system analysis; simulation tools; stability analysis; pole- placement design; digital PID controllers; basic optimal control; basic control system design and implementation issues.

**ME5404/EE5904R Neural Networks**

Modular Credits: 4
Workload: 3-0-0-3-4
Pre-requisite(s): MA2101 (Applicable to undergraduate students only)
Co-requisite(s): Nil
Preclusion(s): MCH5202, EE5904
Cross Listing(s): EE5904

In this module students will learn various neural network models and develop all the essential background needed to apply these models to solve practical pattern recognition and regression problems. The main topics that will be covered are: single and multilayer perceptrons, support vector machines, radial basis function networks, Kohonen networks, principal component analysis, and recurrent networks. There is a compulsory computer project for this module. This module is intended for graduate students and engineers interested in learning about neural networks and using them to solve real world problems.

**ME5405 Machine Vision**

Modular Credits: 4
Workload: 3-0-0-4-3
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil Cross Listing(s): Nil

This module introduces machine vision devices and techniques. At the end of this course, students will understand how machine vision systems in robotics and medical devices, as well as simple image processing programmes, work. This course bases on a basic knowledge of geometry and linear algebra, and does not require previous knowledge in machine vision. The accent is more on global understanding than on mathematical derivations. The main topics that will be treated are: vision hardware, visual perception, optical properties, image transforms, image enhancement, segmentation, encoding, representations, and applications.

**ME5506 Corrosionof Materials**

Modular Credits: 4
Workload: 3-0-0-0-7.5
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil

This module aims to teach the fundamentals and advanced concepts related to the corrosion of metallic materials. Particular emphasis is placed to use case histories so that the students learn to apply the knowledge gained through the lectures. Major topics covered under this module include: Fundamentals of Corrosion; Dry Corrosion; W et Corrosion; Types of Corrosion; Corrosion Prevention; Corrosion of Fe and Al Alloys and Corrosion Testing. This module is useful for both part-time and full- time graduate students who see themselves in a career related to failure analysis and/or materials.

**ME5513 Fracture and Fatigue of Materials**

Modular Credits: 4
Workload: 3-0-0-3-4
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil

The objective is to expose students to the various methods to tackle problems related to fracture and fatigue of materials so that they can apply them to practical situations. Particular emphasis is placed on fracture and fatigue properties of materials. Major topics include: linear elastic fracture mechanics, fracture mechanics in yielded regime, standard tests for fracture toughness; high and low cycle fatigue, factors affecting fatigue properties of materials, conventional fatigue design, fatigue crack propagation, fracture and fatigue mechanisms and control. This module is useful for students who see themselves in a career related to failure analysis and/or materials.

**ME5516 Emerging Energy Conversion and Storage Technologies**

Modular Credits: 4
W orkload: 3-1-0-2-4
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil

The module provides an overview of emerging technologies for environment-friendly power generation and large-scale storage, focusing on post-silicon (organic) photovoltaics, fuel cells, and electrochemical batteries. The science behind each technology will be taught and related to the long-term economic viability, including resource limitations when going from small to large scale production, and externalities. The course will consider the link between the technology and economics of intermittent (solar, wind) energy production and those of storage as well as financial factors determining the final cost of energy.

**ME5608** Additive and Non-Conventional Manufacturing Processes

Modular Credits: 4
W orkload: 3-0-0-1-6
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): ME6605
Cross Listing(s): Nil

This module focuses on principles, techniques and applications of abrasive and non conventional maching process and latest techniques on material additive in addition to material removal. Topics include grinding, ultrasonic maching, electrical discharge maching, laser beam maching, layered manufacturing, et cetera. Students are expected to carry out an independent study by project or term paper on the related topics.

**ME5611 Sustainable Product Design & Manufacturing**

Modular Credits: 4
Workload: 3-0-0-3-4
Pre-requisite(s): Nil Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil

This module embraces the various elements of the sustainability issues of product design and manufacturing. The concepts are reinforced with a 12-week term project where students are required to identify a real industrial product and carry out a detailed analysis of the impact of the product on the various environmental issues. This module will touch on the objectives and trends of sustainable manufacturing. Topics covered include the ISO 14000 – International Environment Standard, Environmentally conscious product design and manufacturing, Environmental cost analysis and business strategy, Eco-labeling schemes, Environmental attributes of manufacturing processes and energy issues, Environmental decision support systems, Marketability issues of environmentally friendly products, and Integrated model for sustainable product design.

**ME5612** Computer Aided Product Development
Modular Credits: 4
W orkload: 3-0-0-3-4
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): ME6606
Cross Listing(s): Nil
Product development relates to the processes and techniques employed in the design and manufacture of a product. This course will focus on the early (conceptual) stages of design and development of mainly mechanical products, looking at the technologies available to convert new ideas into a manufactured reality. Emphasis will be on the practical implications, constraints and in-depth analysis, with an integrated assignment that encourages student groups to investigate the technologies for generation of a product.

**OT5102 Oil and Gas Technology**
Modular Credits: 4
W orkload: 3-0.5-0.5-3-3
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
The module objective is to provide students with a broad overview of the technologies, processes and hardware used in the upstream oil & gas industry. Areas covered include exploration, drilling, completions, oil & gas production, Improved Oil Recovery (IOR) & Enhanced Oil Recovery (EOR), floating production systems, subsea systems and oil & gas processing technologies on both onshore and offshore.

**OT5301 Subsea Systems Engineering**
Modular Credits: 4
Workload: 3-0-0-4-3 Pre-requisite(s): Nil Co-requisite(s): Nil Preclusion(s): Nil
Cross Listing(s): Nil
This module is designed for persons interested in the subsea systems engineering in offshore oil and gas production. Its contents are focused on giving an overview and understanding of subsea systems employed in the subsea production and processing of oil & gas. Contents to cover subsea systems, equipment and their architecture, offshore exploration, drilling, well completion, subsea processing of oil & gas, subsea control systems, flowline, pipline and risers, etc. A structured programme of lectures, seminars, term papers, mini-projects and a final examination are included in this module.

**OT5302 Flow Assurance**

Modular Credits: 4
W orkload: 3-0-0-4-3
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil

Flow Assurance is a relatively new term in the Oil & Gas industry which is all about ensuring the safe and uninterrupted transportation of a multiphase mixture of oil, gas and water from the reservoir to the delivery location. This module is designed for students interested in offshore oil and gas production and the multiphase transportation of oil, water and gas. Its contents are focused on giving an overview and understanding of the various aspects in both single phase and multiphase flow transportation and assurance issues in the oil & gas industry with emphasis on the subsea production and transportation of oil, gas and water. A structured programme of lectures, seminars, term papers, mini-projects and a final examination are included in this module.

**OT5303 Subsea Control**

Modular Credits: 4
W orkload: 3-0.5-0.5-3-3
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil

Subsea Control is an essential and integral part of all subsea systems. This module introduces the fundamentals and principles of subsea control used in subsea systems for oil & gas production. Subsea data communication systems as well as various subsea protocols used are also addressed in this module.

**OT5304 Subsea Construction & Operational Support**

Modular Credits: 4
W orkload: 3-0-0-4-3
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil

The design of subsea systems is significantly affected by operational considerations and can radically change a system configuration. Key considerations that must be taken into account in a subsea system design include vessel availability, design for weather window, reduction in number of operations, elimination of construction risk and ability to perform an early production start-up. This module considers key operational aspects that will be encountered in everyday offshore operations, and will look specifically at technologies that are used in subsea operations that are essential to understand their use and limitations.

**OT5305 Pressures Surges in Oil & Gas Flow Systems**
Modular Credits: 4
W orkload: 3-0.5-1-2-3.5
Pre-requisite(s): Nil Co-
requisite(s): Nil
Preclusion(s): ME5708
Cross Listing(s): Nil
The module is most relevant to the MSc in Offshore Technology. The recoding of the module reflects its link to the MSc in Offshore Technology and the change of the word “liquid” to “oil” more closely reflect the liquid medium that the module deals with and its relevance to the oil & gas industry. This module is also used to fulfil one of the KPIs for the Subsea Engineering Professorship Programme funded through by EDB.

**ME6105 Continuum Mechanics**
Modular Credits: 4
W orkload: 3-0-0-4-3
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
The aim of this module is to introduce the principles and applications of continuum mechanics. Students will understand and apply rigorous principles of kinematics, balance laws, thermodynamics and constitutive laws to relevant areas of solid and fluid mechanics. The topics covered will be: vector and tensor calculus, kinematics of deformation, stress and strain measures, balance laws, principles of thermodynamics, and linear and non-linear constitutive equations. Basic problems in linear and non-linear elasticity, viscoelasticity, and modern materials will be studied.

**ME6204 Convective Heat Transfer**
Modular Credits: 4
W orkload: 3-0-0-3-4
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
The aim of this module is to introduce advanced topics in convection heat transfer. Students will gain a deeper understanding of convection and will develop the ability to formulate and solve convection related heat transfer problems. The topics include: conservation principles, fluid stresses and flux laws, differential equations of the laminar and turbulent boundary layer, integral equations of the boundary layer, momentum and heat transfer for laminar flow, momentum and heat transfer for turbulent flow, introduction to micro-scale convective heat transfer, heat transfer in micro-channels and micro heat exchangers, heat transfer in thin liquid films.

**ME6205 Advanced Topics in Heat and Mass Transfer**
Modular Credits: 4
W orkload: 3-0-0-3-4
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): ME5202
Cross Listing(s): Nil
The objective of this module is to approach the study of heat and mass transfer from an industrial design and application perspective. Students will gain competence to formulate and solve industrial design problems involving various heat and mass transfer processes. The topics to be covered include: heat and mass transfer in industry, modeling of transfer problems, heat transfer in manufacturing technology, cooling of electronic components, design of industrial heat transfer equipment, mass transfer applications such as in cooling coils, cooling towers, industrial drying processes etc.

**ME6303 Advanced Fluid Dynamics**
Modular Credits: 4
W orkload:3-0.5-0-2-4.5
Pre-requisite(s): ME2135 (Applicable to undergraduate students only)
Co-requisite(s): Nil
Preclusion(s): Nil

Cross Listing(s): Nil
This module deals with advanced topics in Fluid Mechanics and Turbulence in fluid flows. The main topics include: (1) Navier-Stokes Equations (derivation and some exact solutions etc).; (2) Laminar Boundary Layer Equations and Methods of Solutions; (3) Stability of Laminar Flows; (4) Turbulent boundary layers (5) Reynolds Decomposition and Turbulent Navier-Stokes Equations; (6)Physical and Dynamical Aspects of Turbulence, Isotropic Turbulence; (7) Length scales and Transport Processes, Coherent Structures; (8) Structures of wall bounded and Free Shear Flows; (9) Atmospheric Turbulence; (10) Statistical tools and Description of Turbulence; (11) Turbulence Models and (12) Measurements Techniques including Hot wire/film, LDA and PIV. At the end of the module, the students should have fundamental and advanced knowledge of Fluid Mechanics and Turbulence in general. It should be able to help them in research and analysis in fluid mechanics.

**ME6405**
Modular Credits: 4
W orkload: 3-0-0-5-2
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
Today many robots such as the self-driving cars and drones are no longer rigidly fixed behind safety barricades in factories. These robots are mobile and operate autonomously in environments that are shared with human beings. In this course, we will look at some of the basic mathematical concepts and algorithms that make up the brain of autonomous mobile robots. Topics that are covered include collision avoidance, motion planning, probabilistic methods and 3D robotics vision.

**ME6406**
Modular Credits: 4
W orkload: 3-0-0-5-2
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
Optimization technique has become a fundamental tool for many applications in science and engineering. Optimization for dynamic system is of particular interest in today's system design and integration. This course will cover both optimization in the static case, as well as modelling dynamic system as Markov system and optimize its performance via dynamic programming.

**ME6504 Defects and Dislocations in Solids**
Modular Credits: 4
W orkload: 3-0-0-0-5
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
The module deals with defects and dislocations in solids, with emphasis on physical understanding of the geometry and arrangement of dislocations. Basic features of the geometry, movement and elastic properties of dislocations are first described. Properties of dislocations associated with their movement, intersections with other dislocations, jogs and multiplication of dislocations will be considered. Effects of defects and dislocations on properties will also be discussed. The main topics include fundamentals of crystallography, types of defects in solids, thermodynamics of defects, dislocations and strength of crystalline solids. The course is suitable for engineering and science graduate students.

**ME6505 Engineering Materials in Medicine**
Modular Credits: 4
W orkload: 3-0-0-3-4
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
This module is designed to provide an in-depth graduate level foundation in biomaterial science and engineering principles. Students will be introduced to the practical aspects of biomaterials in medical devices, in particularly the fabrication of devices, including materials selection, processing, performance, biocompatibility issues and regulatory requirements. Topics of interest include hip prostheses, articular joints, surgical sutures, tissue engineering scaffolds for hard and soft tissues, and case studies of failed medical prostheses. A short research proposal on implanted material for medical devices will be prepared by students, in place of continuous assessment. A problem base
approach teaching methodology will be used to encourage the learning process. On completion of this lecture course, students should be able to suggest suitable biomaterials and plan appropriate processing techniques for given biomedical applications.

**ME6604 Modelling of Machining Processes**
Modular Credits: 4
W orkload: 3-0-0-3-4
Pre-requisite(s): Nil
Co-requisite(s): Nil
Preclusion(s): Nil
Cross Listing(s): Nil
The main objective of this module is to teach the students how to model machining processes. The major topics include an overview of major machining processes and their characteristic factors, modelling of chip formation in metal cutting, modelling of machining characteristics in turning, modelling of machining characteristics in milling, modeling of machining characteristics in drilling, and modelling of work piece material flow stress properties in machining. The target students include Ph.D. students and higher levels of M.Sc., M.Eng. students in the areas of materials and manufacturing.

**MT5002 Management of Industrial R&D**
Module Credit: 4
Workload: 3-0-0-3-4
Pre-requisite(s): Nil
Preclusion(s): Nil
Cross-Listing: Nil
The first part of this module will introduce the 3rd-generation R&D practice which is used currently by successful industrial organizations. The strategic role of R&D in innovation, organization issues in R&D and the evaluation of returns and risks will be presented. The second part of this module will introduce the emerging 4th-generation R&D practice which will augment the current practice in addressing news issues due to discontinuous innovation, increasing importance of tacit knowledge and the need to embrace knowledge management in R&D.

**MT5006 Strategic and New Product Development**
Module Credit: 4
Workload: 3-0-0-4-3
Pre-requisite(s): Nil
Preclusion(s): Nil
Cross-Listing: Nil
Companies live or die by their ability to successfully launch new products into the market place. The basic tenets are: know your market, know your customers and develop products that will delight your customers. The objective of this module is to acquaint students with the theory and practice of New Product Development and New Product Introduction (NPI) methods and systems. The module explores various NPI systems, project and portfolio management skills and an extensive toolbox that contains necessary tools to enable companies to make informed, data-driven decisions. The module combines taking a hands-on project through an NPI Phase Gate System, with relevant cases studies on NPI projects that have succeeded and some that have not.

**MT5007 Management of Technological Innovation**
Module Credit: 4
Workload: 3-0-0-3-4
Pre-requisite(s): Nil
Preclusion(s): Nil
Cross-Listing: Nil
The aim of this course is to help students develop a strong conceptual foundation for managing technological innovation. It introduces concepts and frameworks for how firms can create, commercialize and capture value from technology-based products and services. The course is designed for business managers and engineers who are involved in the research and development, marketing, acquisitions, and strategic assessments of new technologies. Topics covered include (i) the evolution of industries; (ii) technological discontinuities and vertical disintegration; (iii) network effects and standards; (iv) profiting from innovation and intellectual property (IP); (v) R&D management; and (vi) managing knowledge and learning.

**SDM5001 Systems Architecture**
Module Credit: 4
Workload: 3-0-0-5-2
Pre-requisite(s): Nil
Preclusion(s): Nil
Cross-Listing: Nil
Systems Architecture deals with principles of implementation and evaluation of complex systems. Developing architecture is the most abstract function in system/product development. The course examines various notions of systems architecting (including aspects of organizational and information architecture) and offers principles and tools for its development. A wide variety of real-world case studies (including examples of transportation, utility, electronic, mechanical, enterprise, traditional information and document management systems, etc.) will be drawn upon. The course addresses issues such as dealing with legacy and change, enterprise-wide interoperability as well as support for knowledge management.

**SDM5002 Systems Engineering**
Module Credit: 4
Workload: 3-0-0-5-2
Pre-requisite(s): Nil
Preclusion(s): Nil
Cross-Listing: Nil
Systems Engineering is an interdisciplinary approach to realize the successful creation of systems that meet customer and stakeholders requirements with due consideration of the system’s performance and impact over the entire life-cycle. The module covers the fundamental methods and concepts of this approach including those to surface system requirements; architect options and alternatives; model systems; evaluate performance; and analyze trade-offs.

*Updated on May 2018*