University of Glasgow

SINGAPORE INSTITUTE OF TECHNOLOGY

Brief module descriptions related to **BEng (Honours) in Mechanical Engineering**

Engineering Mathematics I	This module commences with a review of the concept of functions with emphasis on the transcendental functions (i.e. trigonometric, exponential and logarithmic functions). Thereafter, the basic concepts of limits, differentiation and integration are introduced followed by applications of the differential and integral calculus. The course ends with an introduction to complex numbers, vectors and matrices that prepare the students for other modules in Year 1.
Fundamentals of Programming	This module is an introduction to the historical and social context of computing, Basic concepts in programming (Data types, Control structures, Functions, Arrays, pointers, Files), Running, Testing and Debugging scripts and programs, Overview of Programming paradigms. Programming concepts are demonstrated in a variety of languages and practiced in a standard programming language (C). The module will also introduce students the best practices in secure coding such as input validation and data sanitization, and issues such as integer exploits and buffer overflows.
Engineering Mechanics	This module supports the development of an understanding of the physical and mathematical fundamentals on which engineering products are based and aims to establish a firm foundation for the development of design skills and applications in the programme. The module introduces students to mathematical models of mechanical systems.
Engineering Design Graphics	Understanding engineering designs is a basic skill expected of all engineers. It is essential because graphics communication and documentation using 2-D drawings and 3-D computer models are a universal means of communicating a design idea clearly and allowing the idea to be converted into physical products. This module is for students in their first year of studies. Student progress shall be assessed through drawing assessment and assignment, final design project, presentations and final report.
Fundamentals of Electronics & Circuits	This module focuses on developing a basic understanding of the fundamentals and principles of analogue circuits. Students will study methods for calculating the behaviour of analogue circuits, including topics such as Ohm's Law, Kirchhoff's Laws; voltage and current generators both ideal and practical; Thèvenin and Norton Theorems; superposition; nodal analysis, AC circuit analysis using complex numbers.
Digital Engineering Skills	This module is a series of lectures and hands-on laboratory sessions that deliver brief introductions to tools and techniques for embedded system solution, digital business, digital marketing, digital analytic. This module uses Internet of Things as the fundamental concept to help students relate to the digital world better and eventually towards Big Data Analytic.
Engineering Mathematics II	This module provides an extension of the basic concepts of differentiation and integration learned in Mathematics 1, operations of functions with multiple variables, advanced applications of differential and integral calculus, as well as series and ordinary differential equations.
Dynamics	This module introduces students to modelling and analysis of dynamic systems, with emphasis on free and forced oscillations, and investigation of the system response. In addition, the solution of the resulting differential equations and the application to simple vibration problems will be discussed.
Control	The module aims to introduce students to the problems of automatic control, with practical illustrations, to provide a basic understanding of techniques used to model engineering systems and to allow students to gain a physical understanding of the factors influencing the steady-state and dynamic response of practical systems. The module also provides an understanding of the time-domain and frequency-domain methods of analysis of control systems, an understanding of the properties of proportional, integral and derivative controllers and to allow students to gain experience of real closed-loop control systems and to learn about analysis methods using computer based techniques.
Effective Communication	This module aims to help students develop effective written and oral communication skills through academic essay and reflective writing, technical report writing, small group discussions, oral pitching and presentation to technical and non-technical audiences. A process-based, reading-into-writing approach is adopted so that students have the chance to learn/unlearn/relearn from the multiple drafting experience of each writing assignment. For the principal instructional focus of the module, a project-based approach is used that requires teams of students to explore authentic engineering problems and develop viable solutions within real-world contexts. Students will read discipline-specific articles, do writing assignments and a project with an engineering focus, and interview engineers or related experts, thus facilitating greater acquaintance with the field.

Sensor & Signal Technology	This module focuses on the principles and applications of measurement, sensing technologies and signal processing. It is intended as a follow-on module from Fundamentals of Electronics and Circuits 1. Students will be taught concepts of measurement uncertainty and errors (both systematic and random), key principles, limitations and applications of a wide range of sensors. The course also aims to teach students the basic concepts of signals and linear time-invariant (LTI) systems, and how to represent and analyse them in both time and frequency domains. In addition, students will be taught the principles of analogue-to-digital and digital-to-analogue conversions, and the requirements and their impact on the sensors and signals. The course provides a grounding in the mathematical tools and transforms (the Fourier and Laplace transforms), and show how these tools can be used in analyses and design. The course also provides practical experience in using MATLAB in analysis, design and simulation.
Materials & Manufacturing Technology	This module introduces materials properties and their selection in mechanical design, joining processes including welding and adhesive bonding, and forming processes for metallic and polymeric materials.
Engineering Mathematics III	This module focuses on the computational solution of important problems of matric algebra, eigenvalues and mathematical modelling. The topics covered include matrix algebra, rank of matrix and solution type, determinant of matrix, eigenvalues and eigenvectors, mathematical modelling, numerical integration and differentiation.
Mechanics of Solids	This module provides students with the ability to apply the principles of engineering mechanics to determine elastic behaviour of members and components subjected to bending moment, shear force, axial force and torque, including elastic deflections of beams (statically determinate and statically indeterminate) and torsion of circular and thin-walled sections. Behaviour of beams is also extended to simple cases of plastic bending behaviour.
Thermodynamics & Heat Transfer	This module is designed to develop students' basic understanding of the laws of thermodynamics which are used in the analysis of common engineering systems. Thermodynamics is an exciting and fascinating subject that deals with energy and energy interactions. The module introduces the concepts of heat, work, efficiency and property diagrams of pure substance while discussing the 1st law of thermodynamics. The ideal-gas equation of state is introduced for ideal gases while real gases are described by other polytropic models. This module then aims to provide students with understanding of the application of thermal energy conversion using thermodynamic principles. Students will learn about steam and refrigeration cycles using 2nd law of thermodynamics. In heat transfer, three main mechanisms of heat flow will be discussed; conduction, convection and radiation. Conduction introduces the Fourier's law with emphasis on developing 1D heat transfer in steady state condition for various structures. There are two modes of convection, namely natural and forced convection, where some convection correlations are derived to demonstrate and allow appreciation of its respective empirical convection heat transfer coefficient in real world. Lastly, the radiation topic will cover basic concepts such as reflection, absorption, transmission and emission. The module will also provide the student with an understanding of heat exchangers and how such items of equipment are designed.
Design & Manufacture I	This project based module introduces the student to a range of modern methods and techniques supporting industrial product design activity. 3D solid modelling CAD skills are developed throughout the project activity.
Mechanics of Mechanisms	This module aims to introduce advanced concepts of kinematic and dynamic modelling and analysis of mechanisms and machines, including linkage mechanisms and cam mechanisms, reciprocating and rotating machinery. Students will learn in depth core mechanical engineering concepts by integrating and applying contemporary analytical, computational and experimental methods. It relates kinematics and dynamics of mechanisms and machines to their design and allows you to relate theory and practice using a problem-based approach.
Automation & Robotics	The module aims to introduce various aspects of robotics and industrial automation with the use of robotic arms, sensors, actuators, and computers. Students will learn to describe positions and orientations in 3D space, derive direct and inverse kinematics, and calculate various physical quantities, e.g., velocities, static forces, and moments, etc. Students will relate these robotic theories to common applications in the industries, such as employing robotic manipulator for autonomous welding, and understand the working principles of various types of sensors, amplifiers, robotic arms, and industrial automation technologies.
Real Time Computing Systems	This module introduces the principles of real time computer systems and illustrates their practical implementation using a system based on an ARM Cortex-M3 microcontroller. The problems of multitasking, which arise when such systems have to respond to several simultaneous external events, are also considered.
Modelling & Simulation	The Finite Element Analysis (FEA) has become a critical tool in the portfolio of modern engineers to analyse the structural and heat transfer properties of engineering designs. This module introduces the theory and solution procedure of the underlying finite element method (FEM) for planar and 3D linear elastic problems as well as heat transfer analyses. The module also focuses on the practical application of FEM in engineering mechanics using commercial FEA software by providing professional guidelines on modelling, mesh generation and validation of the numerical results. During practical lab sessions the students get basic instructions on how to use a popular commercial FEA software package to analyse the stresses in a 3D-printed part and validate the results against experimental data and simplified analytical models. The students finally get to demonstrate their gained FEA skills during individual projects working on more complex 3D geometries to analyse and improve the structural properties of provided design.
Career & Professional Development	This module aims to help you develop necessary career and professional skills to meet the demands of today's workplace. The module comprises three main components: job search skills, written workplace communication and oral workplace communication. The job search component takes you through the entire process of job search, from planning your career to drafting your application and attending the job interview. The second component, with its focus on written communication, introduces you to good practices in written workplace communication, including email correspondence and drafting of technical minutes. The third component looks at oral workplace communication, with opportunities for you to hone your skills in conducting meetings, pitching ideas and presenting technical information.
Mechanical Design	The module provides additional design practice and engineering skills in terms of product development, design process, engineering evaluation, and documentation for the design of mechanical parts and components within engineering systems.

Fluid Mechanics	This module provides a grounding in the fundamental methods of fluid mechanics in both static and dynamic situations. It also introduces general principles such as dimensional analysis, which are widely applicable in engineering.
Additive Engineering	Additive Engineering (AE) is a disruptive technology that is fundamentally distinct from conventional manufacturing technologies. AE spans the complete product life-cycle, from concept-stage design to service part fulfillment. This module provides a holistic understanding of the concept and fundamentals of AE. It covers the principles, methodology and usage of various Additive Manufacturing systems, along with the understanding of pre- and post-processing of AE products. Students will carry out a hands-on design and manufacturing project.
Mechatronics Design	This module provides design practice and engineering skills in terms of product development, design and test, component selection, evaluation, project planning, budgeting and documentation for the design of mechatronics systems. It integrates material taught in numerous modules, both electrical and mechanical.
Electronic System Design	This module is intended for students with some basic knowledge in electronics and circuits, as a follow-on module from Fundamentals of Electronics and Circuits. The aim of the module is to develop student's ability to design analogue and mixed-mode electronic systems. Students will be introduced to specification driven design of analogue systems. Topics covered are low frequency precision design, design of ground and differential signals and low noise design.
Software Engineering	This module aims to introduce students to software engineering principles, processes and techniques that are critical to sustainable software development. Students will learn about the importance and need for software engineering as part of the general design of complicated computer systems, as well as gain knowledge of how to use common software engineering processes. The module starts with an introduction to the Python programming language, which is used later in the module. This is followed by models for developing software, in terms of developer roles and common project development processes. Next, the students are introduced to techniques to capture project requirements and encode/convert them into standard documentation formats. Finally, students will learn about how build better software by selecting an appropriate programming language, applying common design patterns and validating their software through testing and run-time checking.
Specialised Engineering Project	This module focuses on the implementation and delivery of an integrated engineering solution in the following specialised areas: (1) Healthcare Engineering; (2) Robotics & Automation; (3) Smart Design. Students will apply an engineering design process which includes steps such as empathy, problem definition, concept generation, reviewing the conceptual system design, breaking down the system design into component design, prototyping at various stages of design, and validation of design, to propose a feasible engineering solution to a given problem. Knowledge and application of relevant engineering standards will guide students to providing a sound engineering solution. Students will work in teams and will be provided with support and resources to work independently in clarifying and prototyping their ideas to deliver an appropriate proposal. Students are not required to deliver a fully working system but their prototypes should be of sufficient resolution and with sound engineering principles, to demonstrate critical components of their solution. Ample opportunity for team work, discussions, critique and pitching is to be expected. Assessment will be through continuous assessment, peer review, presentations and reports.
Risk and Reliability Analysis	This module develops the students understanding of Availability, Reliability, Maintainability thereby enhancing the students' ability to evaluate design proposals from a number of related viewpoints. In addition, this module illustrates and develops an understanding of robust design from functional performance and manufacture viewpoints, and exposes students to the discipline involved in researching a technical area and producing a report and presentation.
IIoT & Data Analytics I	This module rides on students' foundational understanding of IIOT and data analytics covered in the IIoT and Data Analytics I module It aims to deepen students' understanding of the concepts of IIOT and data analytics in providing new solutions and applications in the industrial space. The first part of the module covers advanced technological aspects of IoT that provide pervasive monitoring, sensing and data communication across hierarchical levels of computation. It covers the architecture of IOT versus machine-to-machine architectures. Following which, it introduces various stages of sensor processing and management that includes smart IoT endpoints, sensor fusion, fog and cloud computing, and energy harvesting in power critical devices. On network communications, students will be exposed to various networking technologies that cover near and long-range communications, as well as IP and non-IP communication systems.
Design & Manufacture II (OIP)	This is an intensive 3-week group design project where students will take as an overseas immersion programme (OIP) at UofG. The project-based module introduces the student to a range of modern methods and techniques supporting industrial product design activity. 3D solid modelling CAD skills are developed throughout the project activity. The aims are to illustrate, practise and develop an appropriate level of practical knowledge and skill relating to the integrated activities of industrial product design and manufacture.
Mechatronics Group Project (OIP)	This is an intensive 3-week group design project where students will take as an overseas immersion programme (OIP) at UofG. This project provides experience of working in a team to develop a mechatronic system that must perform a specified function. It integrates material taught in numerous modules, both electrical and mechanical. The project also introduces planning and the need to keep a budget. Students are divided into teams of about 4–6 that design and construct a mechatronic system to perform assigned tasks, on time and within budget.
IWSP I & II	This is an uninterrupted 8-month duration (2 trimesters) structured learning and work programme which will provide students with unique learning opportunities to achieve the following objectives, i.e. (1) applied learning – integration of theory and practice, acquisition of specialist knowledge and development of professional skills, (2) exposure to real-world conditions - appreciation of real-world constraints in respective industry contexts to develop skills of adaptability, creativity and innovation, and (3) smooth transition to jobs - practical experience which shortens work induction period. Students will have the opportunity to develop innovative solutions for the design and construction projects they are working on. In this way, the IWSP will be a key platform to inculcate the SIT-DNA in every student.

Capstone Project	The Capstone Project (CP) is designed for the students to pursue an in-depth independent study to solve engineering problems, building on their technical knowledge and skills acquired in classrooms, design projects and IWSP (Integrated Work Study Programme). With a focus on Applied Learning, the students will have to propose an individual technical project with strong industrial relevance. This can be either a study of a problem observed during IWSP. During the execution of the CP, the students will aim to achieve the desirable objectives in the most effective ways including obtaining resources. In the process, the students can also develop soft skills such as effective communication, project management and planning, oral presentation, and goal setting. Upon completion, the students will present the final outcome of the project to audience consisting of people with and without engineering background.
Professional Engineering Practice	This module is designed to address several aspects of professional practice for engineering students to aid their transition into employment. It exposes students to organisational structures, objectives, and governance, business evaluation of new products or services, analysis of new product ideas against market demands, and product development lifecycles. Engineering economics and appropriate use of standards, project management techniques and processes, including risk management are covered. It provides exposure to different engineering roles within an organisation and how they influence the overall business direction through strategic and operational planning.
IIoT & Data Analytics II	This module provides a broad introduction to data science which encompasses data analytics, data mining, machine learning, and several other related disciplines. Topics include basic statistical and probability concepts, machine learning, datamining, and statistical pattern recognition. Students will be equipped with the knowledge to use data to develop interactive user interfaces, specialty graphics software, and visualization tools. The module will also draw from numerous case studies and there will be hands-on opportunities for students to apply learning algorithms to building smart robots, text understanding, medical informatics, audio and database mining, etc.
Microelectronics for Engineering Products	With the proliferation of inexpensive programmable microelectronics, the design of consumer products are moving towards incorporating more and more microelectronics to improve its functionality and efficiency. Many functions which are performed by mechanical means are implemented using microelectronics. The module aims to teach students how to design consumer products by using the inexpensive programmable microelectronics technology. The overview of semiconductor devices and integrated circuit industry is discussed first, followed by the introduction of Microcontroller (MCU) technology, particularly Arduino technology. The programming in Arduino will be taught in great detail and various aspects related to incorporating microprocessors in consumer products, such as communication, arithmetic, data converter and power will be discussed.
Advanced Materials Technology	This module aims to introduce the students to the various advanced engineering materials and processing techniques adopted for product and structure design. The students will get to study on various mechanical testing technique such as tensile test, 3-point bending test as well as impact test to analyse the structure integrity of composite (sandwich panel laminate), ceramics and alloys. The different possible failure mode for this material structure such as fracture, fatigue failure and creep/ plastic deformation will be reviewed. The course will also apply tribology technique to measure wear, friction as well as non-destructive inspection for manufactured parts. Surface engineering methods such as surface treatment, coating and spray technique will be implemented to extend the lifespan, reliability and performance of manufactured parts.
Unmanned Systems	This module teaches students the basic concepts of unmanned systems, machine learning, path planning, coordination, artificial intelligence, and optimisation; introduce the concepts and techniques behind autonomous vehicle guidance and coordination; create feasible paths with potential function guidance method. In particular, this module focuses on design and implementation of optimal paths and guidance strategies for unmanned systems with machine learning, incorporating planning, optimising, and reacting (to environment and obstacles) elements. This module also provides practical experience in using MATLAB in analysis, design, simulation, and implementation of planning, guidance and coordination of unmanned systems.
Digital Signal Processing	This module aims to teach students the basic concepts and techniques of digital signal processing (DSP); understand discrete time signals as lists of numbers and how mathematical techniques are used to process these lists in various ways to achieve a desired task and relate to signal processing functions; provide a grounding in the discrete mathematical tools, transforms, and algorithms used in DSP and show how these tools can be used to build working DSP systems; and demonstrate some interesting and useful practical applications of DSP. This module also provides practical experience in using MATLAB in analysis, design, simulation, and implementation of DSP systems and algorithms.