THE DYSON INSTITUTE

Module Information for 2021

Year one

dyson

Module information	
Year 1	
Name of module	**Engineering Mathematics and System Modelling**
Module description	To present, in context, and provide skills in the application of fundamental Mathematics and systems modelling concepts that underpin all of Engineering. To encourage the development of problem solving and modelling skills as required in other Year 1 modules and in order that more advanced material can be tackled in modules taught in later years.
Outline syllabus	• Functions, Algebra and Graphs, • Complex Numbers, • Differentiation and integration of functions of a single variable, • Vectors, Matrices and Determinants, • Matrix Algebra and Linear equations, • Solution of 1st and 2nd Order Ordinary Differential Equations, • Basic Probability • Statistics and hypothesis testing
Method of assessment and weighting attributed to each area of assessment	80% Unseen Examination (3 hours) 20% Assignment (1000 words)

Name of module	Applied Programming 1
Module description	This module introduces scientific computing techniques that can be utilised for solving various engineering problems. The programming concepts are taught using a high-level programming language (Python), with students later being introduced to Matlab with its built-in functions and toolboxes. Concepts related to file handling, data processing and data visualisation will be covered, together with different techniques for developing and optimising programming algorithms in electrical and mechanical domains. The module will be taught using lectures, tutorials and hands-on programming exercises.
Outline syllabus	• Programming fundamentals • Introduction to Matlab • Introduction to Python • Introduction to Matrices and Arrays • Decision Structures • Loops • Operators and Expressions • Functions • Manipulating Files • Data manipulation • Plots and their formatting
Method of assessment and weighting attributed to each area of assessment	40% Test (1 hour) 60% Project (1500 words + presentation)

Name of module	Electrical Circuits and Machines
Module description	This module aims to provide the students with an understanding of the fundamental concepts of electrical engineering (charge, voltage, current, power) and their application in components, topologies, and circuit analysis methods. It also provides students with an understanding of Electrical Machines, their fundamentals, and their applications. Closely aligned with 1st year mathematics, it enables students to apply mathematical techniques in appropriate engineering contexts. Students will be encouraged to develop problem-solving and modelling skills relevant to all branches of engineering.
Outline syllabus	• Introduction to Charge, Current, Voltage, Energy and Power. • Circuit elements, energy storage elements, • Resistive circuits, voltage and current dividers. • Kirchhoff's laws, DC and AC circuit theorems and analysis methods. • RLC electric circuits and filters • Introduction to semiconductors • Fundamentals of Electrical Systems • Electrical power, Phasors, Power factor, and Harmonics • Three-phase systems • Fundamentals of electromagnetism • Electric field and potential • Electromagnets • Transformers • DC Machines • Stepper Motors • Synchronous Machines • Induction Machines
Method of assessment and weighting attributed to each area of assessment	60% Unseen Examination (2 hours) 15% Individual Report (800 words) 25% Group Report (2400 words)

Name of module	Electronic Circuits and Applications
Module description	This module aims to provide the students with an understanding of electronic devices, circuits, and their applications. It will focus on usage of diodes and transistors in analogue circuits for basic rectifiers and stabilised power supplies. It also covers the structure, characteristics and utilisation of operational amplifiers. Digital processing of the sampled analogue variables, together with the flexibility given by the processing software, is also covered. An introduction to sensors and their applications are also covered as applications. Examples and case studies demonstrate the usage of analytical techniques for predicting the performance of power-converting and signal-conditioning circuits and systems.
Outline syllabus	• Diodes, transistors, thyristors as switches • Zener diode applications • Transistors - biasing and amplification in the active region • FET (JFET, MOSFET) • TRIAC • Circuit Design and Prototyping • Voltage regulators • Rectifier and inverter circuits • PWM • Op-Amps: basic structure, characteristics and utilisation. • Feedback principles, open and closed loop circuits. • Transient response & 1st order frequency response • Transfer function, Bode diagrams, Filters • Comparators, op-amps, oscillators • Principles of Digital Systems, ON/OFF control • A/D and D/A converters, resolution • Principles of data transmission and sampling • Sensors, transducers
Method of assessment and weighting attributed to each area of assessment	60% Unseen Examination (2 hours) 20% Individual Report (800 words) 20% Group Report (1800 words)

Name of module	Mechanics I: Statics and Structures
Module description	The aims are to introduce the fundamental principles of statics as applied in an engineering context and to develop skills in system description and modelling. This module provides an overview of fundamental mechanical principles of solids and structures which will be required not only for technical mechanical design, but also for the systematic evaluation and analysis of various engineering problems.
Outline syllabus	• Intro to vector mechanics • Force and moment • Free body diagrams • Equilibrium of particles and force systems • Equilibrium of rigid bodies • Pin-joint structure • Shear force and bending moment diagrams • Stress, strain, elastic constants, Hooke's law • Axial load • Pin-jointed frame lab • Centre of gravity and centroid • Engineer's bending theory, first and second moment of area • Beam deflection due to bending • Introduction to torsion and combined loadings, and column buckling.
Method of assessment and weighting attributed to each area of assessment	60% Unseen Examination (2 hours) 20% Assignment (600 words per group member) 20% Lab (600 words per group member)

Name of module	Thermodynamics
Module description	This module aims to deliver fundamental knowledge on thermodynamics and illustrate its importance to engineering systems. Thermodynamics is the science that is devoted to understanding energy in all its forms and how energy changes form. The module's aim is to supply the necessary analytical tools to study these energy changes when applied in engineering situations. Starting from fundamental concepts of work, heat and thermodynamic properties of matter, the course will cover the laws of thermodynamics and the various usages of the Carnot cycle, heat pumps, and heat exchangers.
Outline syllabus	• Multivariable Functions: the mathematical background to the course. • Hydrostatics: the language of fluids, and the treatment of fluids at rest. • Simple Flows: visualising flow, steady-flow, continuity, and the Bernoulli equation. • First Law of Thermodynamics: systems, processes, reversibility, and energy. • Second Law of Thermodynamics: heat engines, reversibility, and efficiency. • Entropy: changes in entropy, Clausius inequality, Gibb's Equation, and potentials.
Method of assessment and weighting attributed to each area of assessment	60% Unseen Examination (2 hours) 40% Assignment (1200 words per member)