

# **BEng (Hons) Mechanical Engineering - E440**

## **1. Objectives**

The Programme is intended to impart to prospective students the fundamentals of mechanical engineering theory and design. The training Programme comprises both theory and laboratory sessions designed to enable students to develop skills needed in the practice of the profession. The Programme is broad-based to ensure job opportunities in various sectors, namely government, parastatal or private upon successful completion of pre-registration training to the status of professional engineer. The scheme of study also offers adequate background for further studies/research at graduate level and beyond both locally and abroad.

## **2. General Entry Requirements**

As per General Entry Requirements for admission to the University for Undergraduate Degrees.

## **3. Programme Requirements**

2 GCE 'A' Level Passes in Mathematics and one of the following subjects: Physics, Physical Science, Engineering Science, Physics with Chemistry, Design & Technology (Technology).

## **4. (i) Minimum Requirements for Degree Award – 132 Credits**

- For the degree award all core modules prescribed by the Department must be completed.
- Vacation Training & Industrial training must be completed satisfactorily for the award of the degree.

## **(ii) Minimum Requirements for Diploma Award**

A student may opt for a Diploma in Mechanical Engineering provided s/he satisfies the following minimum requirements.

<b>MODULES</b>	<b>CREDITS</b>
Modules from Levels 1 & 2	54
Diploma Project	6
<b>TOTAL</b>	<b>60</b>

The Diploma project would normally be of 8 weeks duration for an input of at least 90 hours.

## **5. Programme Duration:**

	<b>Normal</b>	<b>Maximum</b>
Degree:	4 years	7 years

## **6. Credits per Year: Minimum 18, Maximum 48 subject to Regulation 5 above.**

## **7. Assessment**

Assessment will be based on a written examination of 2 to 3-hour duration (normally a paper of 2 hour duration for modules carrying less or equal to 3.5 credits and 3 hour paper for modules carrying four-six credits) and on continuous assessment done during the semester or year.

Written examinations for all modules, whether taught in semester 1 or in semester 2 or both, will be carried out at the end of the academic year (unless otherwise stated).

The continuous assessment will count for 10-40% of the overall percentage mark of the module(s), except for a Programme where the structure makes for other specific provision(s). Continuous assessment may be based on laboratory work, seminars and/or assignments and **should include at least 1 class test.**

There will be a compulsory class test for all modules taught in semester 1 at the end of semester 1 of the given academic year unless stated otherwise in the Programme Structure.

A minimum of at least 30% should be attained in each of continuous assessment and written examination, with an overall total of 40% for a candidate to pass a module.

Special examinations (e.g. class tests) will be arranged at the end of semester 1 or semester 2 for exchange students who have registered only for one semester. In case of yearly modules, credits will be assigned on a pro-rata basis.

## 9. List of Modules - BEng (Hons) Mechanical Engineering

### CORE MODULES

Code	Module Name	Hrs/Wk	Credits
		L+P	
ELEC 1041Y(1)	Electrical Engineering and Electronics	3+1	7
ELEC 1032Y(1)	Basics of Computer Programming	1+2	4
ELEC 2032(3)	Electromechanical Systems	3+1	3.5
ELEC 2033(3)	Electrical Energy Systems	2+0	2
ELEC 2041Y(3)	Microprocessor and Control Engineering	3+1	7
MATH 2010Y(3)	Engineering Mathematics	3+0	6
MECH 1000	Vacation Training *	-	I or S
MECH 1001Y(1)	Mechanics of Materials & Machines I	2+1	5
MECH 1002Y(1)	Thermodynamics	2+0.5	4.5
MECH 1003Y(1)	Engineering Graphics	2+2	6
MECH 1004Y(1)	Fluid Mechanics	2+0.5	4.5
CSE 1010e(1)	Introduction to Information Technology	O.E.	3
COMS 1010(1)	Communication Skills	D.E.	3
MATHS 1111(1)	Mathematics 1	D.E.	3
MATHS 1211(1)	Mathematics 2	D.E.	3
MECH 2001Y(3)	Materials & Machining Processes	3+1	7
MECH 2002Y(3)	Mechanics of Materials & Machines II	2+1	5
MECH 2003Y(3)	Thermal Science	2+1	5
MECH 2019(3)	Project Appraisal Techniques	2+0	2
MECH 3001Y(5)	Mechanics of Materials & Machines III	2+1	5
MECH 3002Y(3)	Manufacturing Processes & Metrology	2+1	5
MECH 3000	Industrial Training (Semester 2 of Level 3)	-	I or S
MECH 3062(5)	Engineering Management 1	3+0	3
MECH 3061(5)	Maintenance Management	3+0	3
MECH 3065(5)	Heat Transfer I	3+1	3.5
MECH 3064(5)	Engineering Design*	1+2	2
MECH 3063(5)	Hydraulics, Pneumatics & Fluidics	2+2	3
MECH 4000Y(5)	Project		12
MECH 4004Y(5)	Refrigeration, Air Conditioning & Energy Systems	3+0	6
MECH 4005Y(5)	Mechanics of Materials & Machines IV	1.5+0	3
MECH 4205(5)	Engineering Management II	3+0	3

**ELECTIVES**

MECH 4012(5)	Automotive Systems	3+0	3
MECH 4009(5)	Heat Transfer II	3+0	3
MECH 4010(5)	Energy Management	3+0	3

\* To be assessed by continuous assessment only

**10. Programme Plan – BEng (Hons) Mechanical Engineering****YEAR/LEVEL 1**

<b>Code</b>	<b>Module Name</b>	<b>Hrs/Wk L+P</b>	<b>Credits</b>
<b>CORE</b>			
ELEC 1041Y(1)	Electrical Engineering and Electronics	3+1	7
ELEC 1032Y(1)	Basics of Computer Programming	1+2	4
MECH 1001Y(1)	Mechanics of Materials & Machines I	2+1	5
MECH 1002Y(1)	Thermodynamics	2+0.5	4.5
MECH 1003Y(1)	Engineering Graphics	2+2	6
MECH 1004Y(1)	Fluid Mechanics	2+0.5	4.5
CSE 1010e(1)	Introduction to Information Technology	O.E.	3
COMS 1010(1)	Communication Skills	D.E.	3
MATHS 1111(1)	Mathematics 1	D.E.	3
MATHS 1211(1)	Mathematics 2	D.E.	3
MECH 1000	Vacation Training*	-	0 (I or S)

**YEAR/LEVEL 2**

<b>Code</b>	<b>Module Name</b>	<b>Hrs/Wk L+P</b>	<b>Credits</b>
<b>CORE</b>			
ELEC 2032(3)	Electromechanical Systems ( <b>Sem 2 Only</b> )	3+1	3.5
ELEC 2033(3)	Electrical Energy Systems ( <b>Sem 2 Only</b> )	2+0	2
ELEC 2041Y(3)	Microprocessor and Control Engineering	3+1	7
MECH 2001Y(3)	Materials & Machining Processes	3+1	7
MECH 2002Y(3)	Mechanics of Materials & Machines II	2+1	5
MECH 2003Y(3)	Thermal Science	2+1	5
MECH 2019(3)	Project Appraisal Techniques ( <b>Sem 2 Only</b> )	2+0	2
MATH 2010Y(3)	Engineering Mathematics	3+0	6

**YEAR/LEVEL 3**

<b>Code</b>	<b>Module Name</b>	<b>Hrs/Wk L+P</b>	<b>Credits</b>
<b>CORE</b>			
MECH 3001Y(5)	Mechanics of Materials & Machines III	2+1	5
MECH 3002Y(3)	Manufacturing Processes & Metrology	2+1	5

**MECH 3100 Industrial Training will be done in Semester 1 of Level 3.**

**SEMESTER 2 CORE MODULES**

<b>Code</b>	<b>Module Name</b>	<b>Hrs/Wk L+P</b>	<b>Credits</b>
MECH 3062(5)	Engineering Management 1	3+0	3
MECH 3061(5)	Maintenance Management	3+0	3
MECH 3065(5)	Heat Transfer I	3+1	3.5
MECH 3064(5)	Engineering Design*	1+2	2
MECH 3063(5)	Hydraulics, Pneumatics & Fluidics	2+2	3

\* To be assessed by continuous assessment only

#### YEAR/LEVEL 4

<b>Code</b>	<b>Module Name</b>	<b>Hrs/Wk L+P</b>	<b>Credits</b>
<b>CORE</b>			
MECH 4000Y(5)	Project	-	12
MECH 4004Y(5)	Refrigeration, Air Conditioning & Energy Systems	3+0	6
MECH 4005Y(5)	Mechanics of Materials & Machines IV	1.5+0	3
<b>SEMESTER 2 CORE MODULE</b>			
MECH 4205(5)	Engineering Management II	3+0	3
<b>ELECTIVES      CHOOSE ONLY ONE FROM</b>			
MECH 4012(5)	Automotive Systems	3+0	3
MECH 4009(5)	Heat Transfer II	3+0	3
MECH 4010(5)	Energy Management	3+0	3

**Total number of credits for the award of the degree = 132**

#### **11. Outline Syllabus**

This outline syllabus is not prescriptive and is intended to serve as a guide only.

Note: Pre-requirement (PQ), Pre-requisite (PR).

##### **CSE 1010e(1) - INTRODUCTION TO INFORMATION TECHNOLOGY**

IT and Computers; Stepping in the Computer; Input and Output Devices; Secondary Storage; Programming; Systems Software; Applications Software; Systems Development; Computer Networks; The internet; Computer Security; Software Utilities; Issues and Trends in IT.

##### **COMS 1010(1) - COMMUNICATION SKILLS**

Writing skills, non-verbal communication, modes of speech delivery and presentation aids, speeches, perception and listening skills, business and technical writing.

##### **ELEC 1032Y(1) - BASICS OF COMPUTER PROGRAMMING**

Introductory concepts, C fundamentals, Operators and Expressions, Data Input and Output, Flowcharts and Pseudocodes, Control Statements, Functions, Arrays, Pointers, Data files, Structures.

##### **ELEC 1041Y(1) - ELECTRICAL ENGINEERING AND ELECTRONICS**

Current Electricity, Electrical components and their characteristics, Electrical Power and Energy, Dc circuit analysis, Network Theorems, Magnetism and Electromagnetic Induction, Single Phase Ac circuits and phasor diagrams, Power factor, Semiconductors, Diodes, Transistors, Op-amps, Digital Logic, Combinational Logic Circuits, Measurement System elements, Sensors and Transducers, Signal Conditioning Circuits, Error Classification, Uncertainty analysis.

##### **ELEC 2041Y(3) - MICROPROCESSOR AND CONTROL ENGINEERING**

Binary and Hexadecimal representation of numbers. Binary arithmetic. Architecture of 8085 microprocessor. Introduction to Assembly level and Machine Code programming. Internal Registers. Software Concepts Addressing Modes, Data transfers. Instruction sets for 8085. Data Processing. Further Programming. Test and Branch. Stack (software and hardware), subroutines, CALL instructions. Encoder/decoder, tristate. Memory Systems and types of memories, memory interfacing. Parallel data transfer and programmable interface chips.

Modelling of Mechanical, Thermal, Hydraulic, Pneumatic, and Electrical systems. Block Diagrams and Signal Flow Graph. State Space model. Transient Response Analysis of second and higher order systems.

Stability Analysis. Control Actions. PID controllers. Root Locus Analysis. Frequency Domain Analysis: Bode Diagram, Nichols Chart Analysis.

**ELEC 2032(3) - ELECTROMECHANICAL SYSTEMS (PQ:ELEC 1041Y(1))**

Magnetic Circuits and Energy Conversion in Machines. Transformer Theory, Connection and Operation. DC Machines: Principles and Characteristics/Operation of DC Motor and Generators. Induction Machines: Principles, Applications and Operation. Synchronous Machines.

**ELEC 2033(3) - ELECTRICAL ENERGY SYSTEMS**

Electrical Energy Demand, Power Plant Economics, Thermal Power Stations, Hydro-Electric Power Stations, Diesel Electric Power Stations, Gas Turbine Plants, Introduction to Transmission and Distribution, Introduction to Switchgear and Protection.

**MATHS 1111(1) - MATHEMATICS 1**

Calculus of one and several variables. Polar coordinates. Complex numbers. Hyperbolic functions. Limits. Ordinary differential equations.

**MATHS 1211(1) - MATHEMATICS 2**

Matrix Algebra: Matrices and determinants. Solution of linear systems of equations. Eigenvalues and eigenvectors. Infinite Series: Comparison test and Ratio test for non-negative series. Vector Algebra: Scalar and vector products, triple products. Vector equations. Vector Analysis: Gradient, divergence and curl. Line and multiple integrals. Green's theorem in the plane, Divergence theorem and Stokes' theorem.

**MATH 2010Y(3) - ENGINEERING MATHEMATICS (PQ: MATHS 1211(1))**

Laplace Transforms: Introduction to transforms and operators, Laplace transforms of basic functions, unit step function, transforms of 1<sup>st</sup> and 2<sup>nd</sup> derivatives, applications, transfer functions, inverse Laplace transforms, derivation using partial fractions, Direct (s-domain) analysis of mechanical systems, interpolation of s-domain functions, system poles and their effect on system response, initial and final value theorems, transforms of piecewise continuous functions; Fourier Transforms; Fourier Series; Matrix solution of simultaneous linear equations, row reduction methods, Gaussian and Gauss Jordan elimination, consistency of simultaneous linear equations, transpose and inverse of a matrix, use of inverse to solve simultaneous linear equations, determinants, properties of eigenvectors, diagonalisation, couples linear systems; Generating functions: Recurrence relations, Proof using mathematical induction; Probability and statistics: Permutations and combinations, random events and assignment of probability, axioms of probability, Venn diagrams, independence, conditional probability and Baye's rule, Bernoulli trials, discrete and continuous random variables, Probability density (PDF) and cumulative distribution (CDF) functions, mean and variance, uniform, Gaussian and Poisson PDFs, The Central Limit Theorem, Estimation and Hypothesis testing, Linear regression and correlation, Examples in Mechanical Engineering.

**MECH 1001Y(1) - MECHANICS OF MATERIALS AND MACHINES I**

Applied Mechanics Concepts, Direct Stress and Strain, Frameworks, Shear and Torsion, Shear Force and Bending Moment, Bending of Beams, Simple Harmonic Motion, Velocity & Acceleration Diagrams, Balancing, Crank Effort Diagrams, Belt Drives.

**MECH 1002Y(1) -THERMODYNAMICS**

Introduction: Basic Concepts; thermodynamic properties, the system, work and heat, temperature, processes. 1<sup>st</sup> Law: The closed cycle, first law, internal energy, corollaries. reversibility and reversible process  $W=pdv$ , constant temperature/volume/pressure processes, enthalpy. Isothermal, adiabatic, polytropic processes, ideal gas laws. Stema and its properties, dryness fraction. Open System. Steady flow energy equation. Application to boiler, turbine, compressor, pump, etc.

2<sup>nd</sup> Law: Heat engine, Clausius version of 2nd Law, reversibility, thermodynamic temperature scale. Entropy: Entropy, T-s & h-s diagrams for water/steam. Air standard cycles; Carnot engine cycle, Rankine, Otto and Diesel cycles. Combustion: Chemical reactions and equations. Stoichiometric A/F ratio.

**MECH 1003Y(1) - ENGINEERING GRAPHICS**

Introduction to Drawing Office Practice, BS 308, etc; Geometrical constructions; Blending of curves; Linkages, Locus, Ellipse, cycloid, epicycloid, etc; Introduction to development (Prisms, cylinders, etc);

Orthographic Projection (systems of projection); Dimensioning and Tolerancing; Sections and sectional views. Introduction to isometric projection; Standard Parts (Threading, Fasteners, etc); Assembly Drawing. Further Isometric projection, True lengths & True Shapes, Further Development & Interpenetration, Development of Truncated Parts & Transition pieces, Assembly & Working Drawings, Drawing analysis, Cams, Gearing & Gears, Piping Drawing, Welding representation, Limits, Fits and Tolerances- BS 4500, Geometrical Tolerancing, Freehand sketching & Perspective Drawing.

#### **MECH 1004Y(1) - FLUID MECHANICS**

Fundamental Properties of fluids: Density, specific gravity, compressibility, viscosity.

Fluid statics: Variation of pressure within a static fluid. The hydrostatic pressure equation, manometry, hydrostatic pressure forces, Buoyancy, Basic concepts of incompressible steady fluid flow, the continuity equation, the Bernoulli's equation, Dimensionless Analysis: Geometric, Kinematic, and Dynamic Similarity. Buckingham's Pi theorem, Dimensionless groups and significance. Viscous flows: Boundary layers, Reynolds Number.

#### **MECH 2001Y(3) - MATERIALS & MACHINING PROCESSES**

Fundamentals of Materials & chemistry of materials; Properties of materials (hardness, ductility, UTS, etc.); Heat Treatment & Microstructure Analysis of common metals (Iron, different carbon steels, copper, aluminium); Production of materials, Properties & Applications (Iron & Steel, Copper, Aluminium, Plastics, Composites, Ceramics, Elastomers, etc.); Case studies to demonstrate selection of materials for particular applications; Machining processes: Turning, Milling (including gear and thread cutting), Drilling, Shaping, Reaming, Grinding & Finishing Processes; Tools; Machinability; Economics of Machining; Non-conventional machining processes: EDM, ECM, USM; Joining Processes (Fusion and Solid State welding, Adhesive bonding, Mechanical fastening).

#### **MECH 2002Y(3) - MECHANICS OF MATERIALS AND MACHINES II (PQ: MECH 1001Y(1))**

Strain Energy, Complex Stress and Strain, Theories of Elastic Failure, Thick Cylinders, Torsion of Non-Circular Sections, Cams, Clutches, Gear Trains, Gyroscopes.

#### **MECH 2003Y(3) - THERMAL SCIENCE (PQ: MECH 1001Y(1))**

Heat Engine Cycle; Steam Boiler, Steam Plant, Displacement Machines, Nozzles, Mixtures; Introduction to Combustion and Internal Combustion Engines. Hydraulic machinery. Pumps.

#### **MECH 2019(3) - PROJECT APPRAISAL TECHNIQUES**

Introduction to different branches of Economics. Microeconomics: Supply and Demand Analysis, Monopoly & Competition Macroeconomics: National Income Accounting, Multiplier Effect, Open and Closed economies. Engineering Economics: Investment Appraisal Techniques, Resource and Environmental economics. Welfare Economics: Indifference curves, Choices for the development of society. Accounting for decision-making: concepts, Elements of Costing methods and Techniques, Accounting ratios, applications to engineering.

#### **MECH 3001Y(5) - MECHANICS OF MATERIALS AND MACHINES III (PQ: MECH 2002Y(3))**

Unsymmetrical Bending, Strains Beyond Elastic Limit, Stresses due to Rotation and Thermal Gradients, Circular Plates and Diaphragms, Finite Element Method of Stress Analysis, Free Vibrations, Transverse Vibrations of Beams, Whirling of Shafts, Torsional Vibrations.

#### **MECH 3002Y(3) - MANUFACTURING PROCESSES AND METROLOGY**

Casting, Forming processes, Powder Metallurgy, Metrology (Standards, Dimensional Properties & Errors, Tolerance, Fits & Gauges, Linear Measurement, Comparators & Angular Measurement, Introduction to Surface Texture Measurement, Surface Roundness Measurement, Interferometry, Introduction to CMM), Tribology (Wear Data & Mechanisms, Oil Analysis, Introduction to Maintenance Engineering), Corrosion, Surface Engineering (PVD, CVD, Plasma Nitriding, Ion implantation, etc), Testing: Destructive and Non Destructive Testing Methods.

**MECH 3100 - INDUSTRIAL TRAINING**

The industrial attachment is for a minimum period of 20 weeks to be undertaken within a company. The industrial training report will be assessed.

**MECH 3062(5) - ENGINEERING MANAGEMENT I**

Introduction to the Production and Operations Management; Decision Analysis; Capacity Planning; Process Selection and Facility Layout; Location Planning and Analysis; Introduction to Quality; Introduction to Inventory Management: Requirements of an effective Inventory Management System; EOQ & EBQ models, Reorder levels, Quantity Discounts; Materials Requirement Planning; Project Management.

**MECH 3064(5) - ENGINEERING DESIGN**

Course Introduction, Design for Quality and Manufacturability, Manufacturing Considerations for Designers, Conceptual Design, Generating Design Specifications, Evaluating Design Alternatives. Material Selection, Design Problem Formulation and evaluation, Mechanical Component Design, Communicating Engineering Design, Patents, Liability and Ethics, Design Project Presentation.

**MECH 3061(5) - MAINTENANCE MANAGEMENT**

Introduction to Maintenance, Failure mode of mechanical components, FMECA, FTA, Introduction to reliability engineering, Safety engineering, Maintenance management practices (breakdown, preventive, predictive, CBM, RCM).

**MECH 3065(5) - HEAT TRANSFER I (PQ: MECH 1002Y(1))**

Introduction to Conduction, Convection and Radiation. One Dimensional Steady State Conduction, External and Internal Flows, Free Convection, Radiation Processes and Properties.

**MECH 3063(5) - HYDRAULICS, PNEUMATICS AND FLUIDICS (PQ: MECH 1002Y(1))**

Pneumatics & Hydraulics Systems; Standards; Generation of Pneumatic & Hydraulic Power; Design and Implementation of Pneumatics and Hydraulics Circuits; Pneumatics and Hydraulics Components – Valves, Actuators, etc; Design of cascade circuits and troubleshooting; Electrohydraulic & Electropneumatic Systems and Components; Proportional Control; Systems Integration and Interfacing to PLC's and Microprocessors; Safety Aspects; Applications and Comparisons between Different Systems. Demonstration. Fluidics. Wall attachment principle; Fluidic elements - applications.

**MECH 4000(5) - PROJECT**

Project in Mechanical/ Manufacturing Engineering and Related Areas.

**MECH 4004Y(5) - REFRIGERATION, AIR CONDITIONING & ENERGY SYSTEMS**

Introduction to Refrigeration cycles; p-h, T-S, & p-v charts, Vapour Compression Cycle and System Analysis; Multiple Evaporators and Compressors Systems Equipment: Compressors, Evaporators, Condensers, Throttle Valves, Properties of Refrigerant; Refrigerant and the Ozone Layer, Introduction to Air Conditioning; Psychrometric Charts: Comfort air conditioning and Industrial Air Conditioning, Factors affecting Human Comfort; Air quality and Standards, Air Conditioning for Tropical Climates Determination of Cooling Load, Air Conditioning Systems and Equipment Selection, Design of Ducting and Piping Systems Installation, Commissioning and Maintenance of Refrigeration Equipment, Thermal Storage Systems; Partial and Full Energy Conservation and Management (related to Air Conditioning).

Fuels; Combustion; Energy Production; Boilers; Steam Engineering; Turbomachinery; Impulse turbines; Reaction turbines; Condensers; Cooling Towers; Efficiency Analysis; Energy Recovery Systems; Cogeneration.

**MECH 4005Y(5) - MECHANICS OF MATERIALS AND MACHINES IV (PQ: MECH 3001Y(5))**

Advanced Elasticity Theory, Contact and Residual Stresses, Stress Concentrations, Fatigue, Creep and Fracture, Damped, Forced and Forced-Damped Vibrations.

**MECH 4205(5) - ENGINEERING MANAGEMENT II (PQ: MECH 3062(5))**

Human Resource Management: Evolution of Management, Types of leadership, Motivation, Recruitment, Training and Development, Evaluation, Control and Reward System.; Industrial Relations & Law: Industrial Disputes and Discipline, Workers bargaining power and participation; Introduction to Marketing: The

marketing Environment, Customer buying behaviour, Segmentation, Targeting and Positioning, The 4 P's of Marketing; Contracts & Tendering.

**MECH 4012(5) - AUTOMOTIVE SYSTEMS**

Engine, Fuel, transmission, Suspension and Braking Systems, Chassis and Body Shell, Electrical and Electronic Vehicle Applications, Engine management and Exhaust Systems, Overall maintenance Schedules, Environmental Issues, Noise, Air Pollution, Road Wear, Safety, Congestion Developments in Electronic systems, New Materials.

**MECH 4009(5) - HEAT TRANSFER II (PQ: MECH 3065(5))**

Steady State Conduction with Generation, Internal Flow, Radiation Exchange, Heat Exchangers and Heat Pipes, Boiling and condensation, Combined Modes of Heat Transfer.

**MECH 4009(5) - ENERGY MANAGEMENT**

Energy - Generation, Distribution and Utilisation of Energy - Total Energy Systems – Policy and Planning- Sustainable Energy Use - Energy Management - Transport - Textile Industry - Sugar Industry - Domestic Sector - Services - Renewables (including Solar and Wind) - E5 dimensions of Energy - Energy Audit - Programmes - Case Studies in Mauritius and in the Region.