BEng (Hons) Manufacturing Engineering - E442

1. Objectives

The Programme is intended to impart to prospective students the fundamentals of manufacturing engineering. 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 Manufacturing Engineering provided s/he satisfies the following minimum requirements.

MODULES	**CREDITS**
Modules from Levels 1 & 2	54
Diploma Project	6
TOTAL	**60**

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

5. Programme Duration

	Normal	**Maximum**
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.

8. Programme Plan – BEng (Hons) Manufacturing Engineering

YEAR/LEVEL 1

Code	Module Name	Hrs/Wk L+P	Credits
CORE			
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

Code	Module Name	Hrs/Wk L+P	Credits
CORE			
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 3004Y(5)	Business and Manufacturing Strategy	2+0	4
MGT 2078Y(3)	Industrial Marketing and Supply Chain Mgt	3+1	6
MATH 2010Y (3)	Engineering Mathematics	3+0	6
SEMESTER CORE MODULE			
MECH 2019(3)	Project Appraisal Techniques	2+0	2

* To be assessed by continuous assessment only

YEAR/LEVEL 3

Code	Module Name	Hrs/Wk	Credits

		L+P	
CORE			
MECH 3001Y(5)	Mechanics of Materials & Machines III	2+1	5
MECH 3002Y(3)	Manufacturing Processes & Metrology	2+1	5
SEMESTER CORE MODULES			
MECH 3062(5)	Engineering Management 1	3+0	3
MECH 3067(5)	Design of Work Systems	2+0	2
MECH 3064(5)	Engineering Design*	1+2	2
MECH 3066(5)	Computer Aided Engineering	2+2	3
MECH 3068(5)	Quality Systems	3+0	3

MECH 3000 Industrial Training will be done in Semester 2 of Level 3.

YEAR/LEVEL 4

Code	Module Name	Hrs/Wk L+P	Credits
CORE			
MECH 4000(5)	Project	-	12
MECH 4001Y(5)	Operational Research	3+0	6
MECH 4002Y(5)	Manufacturing Systems Engineering	2+1	5
MECH 4003Y(5)	Reliability & Safety Engineering	1.5+0	3
SEMESTER 1 CORE MODULE			
MECH 4104(5)	Entrepreneurship & Enterprise Studies	2+0	S or I
SEMESTER 2 CORE MODULE			
MECH 4205(5)	Engineering Management II	3+0	3
ELECTIVES	**ANY ONE FROM**		
MECH 4006(5)	Advanced Manufacturing Systems	2+0	2
MECH 4011(5)	Pneumatic & Hydraulic Systems	2+1	2.5

* To be assessed by continuous assessment only

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

9. Outline Syllabus

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

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

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.

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.

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.

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^{st} and 2^{nd} 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^{st} 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^{nd} 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 1002Y(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 3004Y(5) - BUSINESS AND MANUFACTURING SRATEGY
Introduction to Strategy Formulation at: Corporate level, Business level, Functional level. Portfolio Analysis (BCG Matrix, GE Matrix). Strategy Formulation: Ansoff Matrix, Strategic Planning: Tools and Techniques. Environmental Scanning: The SWOT Analysis, Analysis of the Competitive Environment (Porter's Five forces model). Porter's Generic Strategies (cost leadership, differentiation, focus), Identification and evaluation of strategic alternatives. Strategy Implementation: Framework for understanding implementation issues, Tactical aspects of strategy implementation. Strategy Evaluation and Control.
Strategic issues in Manufacturing, Value Chain, Manufacturing Strategy Content and Process, Manufacturing Strategy Auditing, Product Design and Development, Process Choice and Strategy, Quality as a Strategic Factor, Strategic importance of Inventory Management, Strategic Human Resource Management, Lean manufacturing, Strategic Choices in Manufacturing, World Class Manufacturing.

MECH 3000 - 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 3067(5) - DESIGN OF WORK SYSTEMS
Method Study (procedures, charting, micro-motion study); Work Measurement (Procedures, rating, setting standards); Design of Plant Layout' Workplace Engineering; Organisation of Work Study department; Techniques to reduce work content; Work Physiology; Man-Machine system (characteristics and classification); Design of Displays; Design of Control; Human and Workplace Design; Effect of Climate, noise, vibrations, vision, lighting and aeration on human performance; Industrial Design and Ergonomics.

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 3066(5) - COMPUTER AIDED ENGINEERING
Fundamentals of CAD and CAM, Economics of Production Automation, Computer Aided Design Introduction to Numerical Control, Advantages and Economics of NC, CNC, DNC and Adaptive Control, Manual Part Programming, Computer Aided Part Programming, Programming CNC Machines, Using CAD/CAM Systems, CAD/CAM Interfacing.

MECH 3068(5) - QUALITY SYSTEMS
Total Quality Management, productivity and cost relationships; quality systems and their components (including international standards such as ISO 9000); interaction between quality and design functions; Pareto analysis and Cause & Effect diagrams; Quality Control; Statistical Process Control: control charts for variables; process variability and process capability; control charts for attributes; Quality planning: QFD; Experimental Design for quality improvement: Taguchi Design of Experiments.

MECH 4000(5) - PROJECT
Project in Mechanical/ Manufacturing Engineering and Related Areas.

MECH 4001Y(5) - OPERATIONAL RESEARCH (PQ: MECH 3062(5))
Linear Programming Techniques, Forecasting Techniques, Decision Theory, Inventory models, MRP 1 & II, Queuing Theory, Network Models, Theory of Games, Simulation, Dynamic Programming, Replacement Theory, Markov Analysis, Sequencing, Goal programming.

MECH 4002Y(5) - MANUFACTURING SYSTEMS ENGINEERING

Fundamentals Of Manufacturing & Automation; Group Technology (including case studies); Flexible Manufacturing Systems (including case studies); Robotics: Kinematics, Robot characteristics, Robot Cell Design and Control, Robot Implementation and safety requirements, End Effectors); Sensors; Robot Vision; Simulation of Manufacturing Systems: concepts, types of application, available systems, Introduction to computer-assisted simulation using WITNESS software, Conceptual Modelling, Developing the Conceptual Model, Data Collection, Experimentation and Analysis of results, case studies and mini-project; Introduction to PLCs.

MECH 4003Y(5) - RELIABILITY & SAFETY ENGINEERING

Reliability: Definition of reliability, failure determination and measures; Failure frequency distributions; Graphical analysis of item failure data, Trend analysis, Reliability and Availability Assessment of systems; Failure Mode Effect & Criticality Analysis (FMECA); Fault Tree Analysis (FTA); Implications for Maintenance; Industrial Case Studies.

Definition of critical maintenance terms, the basic model of the maintenance system, Maintenance approaches, relationship between reliability and failure, common types of failure in components, safe system of work for maintenance, Principles of preventive maintenance: definition of a plant item, maintainability diagrams, Models for optimising the balance of preventive and corrective work, Selection of the best maintenance procedure in the light of cost and safety factors, The Top-down Bottom-up (TDBU) approach to the formulation of maintenance strategy, Introduction to Reliability-Centred Maintenance, its uses and limitations, Total Productive Maintenance, Integrated Condition Based Maintenance, Machine Life cycles, Trend Monitoring, Parameter Symptom limits, Thermal monitoring, Lubricant monitoring, Vibration monitoring, Machine faults and frequency range of symptoms.

Safety: *The Workplace*: Safety of the Workplace, Safety in Construction and Demolition Work, Safety during Maintenance Work, Work in Confined Spaces, Fire Safety, Storage of Flammable Materials, Fire and Explosion Hazards and Precautions, Safe Use of Electricity, Chemical Process Safety, Safe Working Practices in Construction and Demolition Work, Storage and Transport of Flammable, Toxic and Corrosive Substances, Environmental Pollution and Waste Management.

Work Equipment: Selection, Use and Maintenance of Work Equipment, Basic Machinery Safety, Safety in the Movement of People and Materials, Electrical Equipment Safety, Plant and Machinery Safety Programmable Electronic Systems, Integrity of Materials and Components, Pressure Systems.

Relevant legislation for Occupational Health & Safety in Mauritius.

MECH 4104(5) - ENTREPRENEURSHIP & ENTERPRISE STUDIES

Introduction to Entrepreneurship and Enterprise in the Economy: the characteristics of the entrepreneur, the motivating factors for entrepreneurship, definitions entrepreneurship, the role of small business in an economy: definitions, problems, opportunities and policies, the role of finance, Innovation and Entrepreneurship: sources of innovation, relevance of sources to the entrepreneur, New Product Development Strategies, Technology Adoption Life Cycle.

The student will also be expected to develop a business plan for a new enterprise.

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 4006(5) - ADVANCED MANUFACTURING SYSTEMS

MRP, JIT and Synchro MRP: MRP review; Lot sizing-single and multilevel. JIT review; Kanbans; determination of numbers; Lot sizing; single and dual Kanban control; Synchro MRP; Methodology, Applications; Leveling of production; Lot sizing.

Flexible Manufacturing Systems: Flexibilities; Frameworks; Tool Management; Information management.

Agile Manufacturing: Agility in systems; Scope and utility; Applications.

Lean Manufacturing: Levels of understanding Lean manufacturing; quality in lean systems; Steps to establish Lean Manufacturing environment; Motion and Time study in Lean manufacturing; Measures of performance in Lean Manufacturing.

MECH 4011(5) - PNEUMATIC AND HYDRAULIC SYSTEMS

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. Laboratory Demonstration.

MGT 2078Y(3) - INDUSTRIAL MARKETING & SUPPLY CHAIN MANAGEMENT

The industrial marketing System: Participants, channels, the relationships. Demand and product characteristics. The industrial customer. Purchasing systems. Value and vendor analysis. Marketing intelligence system. Marketing strategy; Product and service component, the price component, the promotional component, the channel component. Industrial marketing control-Strategic goals and instruments of control .

Understanding the Supply Chain. Supply Chain Performance: Achieving Strategic Fit & Scope. Supply Chain Drivers and Obstacles. Demand Forecasting in a Supply Chain. Aggregate Planning in the Supply Chain.: Managing Predictable Variability. Managing Economies of Scale in the Supply Chain: Cycle Inventory. Managing Uncertainty in a Supply Chain: Safety Inventory. Determining Optimal Level of Product Availability. Transportation in the Supply Chain. Facility Decisions: Network Design in the Supply Chain. Information Technology and the Supply Chain. Coordination in the Supply Chain. E-business and the Supply Chain. Financial Evaluation of Supply Chain Decisions.