UNIVERSITY of TECHNOLOGY, MAURITIUS

School of Innovative Technologies & Engineering

Department of Industrial Systems Engineering

BEng (Hons) Electrical Engineering (Top-Up)

PROGRAMME DOCUMENT

VERSION 2.3
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BEng (Hons) Electrical Engineering (Top-Up)

A. Programme Information

This programme is a top-up degree and is designed to integrate a wide variety of study areas such as engineering, research, planning, and management. This programme will equip graduates to be the engineers of tomorrow while developing their professional qualities and skills as electrical engineer. They will also acquire the technical tools and abilities required for effective professional practice.

In levels 3 and 4 of the programme, the students will be exposed to advanced modules such as Power Management and Power Electronics. Also, the students will have a higher degree of freedom to select some specific engineering specialist modules. The students will also have to complete a final year project to be qualified for the BEng (Hons) award.

The Bridge Modules

The bridge modules are introduced in the programme and the aims is to provide an introduction to fundamental and important topics such as foundation and engineering maths, principles of engineering, material science, measurements and instrumentations, electric power generation and engineering management amongst others in order to ensure that the students have sufficient knowledge and aptitude to cope with the more advanced modules that follow as well as to ensure that they have same knowledge and skills as full time students who are following four-year BEng programme in order to be able to apply their engineering skills, combining theory and experience, and to use other relevant knowledge and skills which include knowledge of characteristics of particular materials, equipment, processes, or products, workshop and laboratory skills, knowledge of quality issues, knowledge of codes of practice and industry standards, ability to work with technical uncertainty etc.

Research Methods Seminar for Engineers

The aim is to present a 2-day seminar (12 hours) on scientific approaches to research in engineering (with a specific emphasis on the difference between research and implementation). The seminar will help the students to acquire knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline. The students will be able to demonstrate creative and innovative ability in the synthesis of solutions and in formulating designs and to comprehend the broad picture and thus work with an appropriate level of detail in engineering fields.

B. Programme Aims

The programme aims to provide the students with:

- a curriculum which provides a broader range of subjects to facilitate the development of skills, abilities, pursuit of interest and promotion of career development
- the ability to contribute to the new and modern development and management of electrical facilities and systems
- a wide range of transferable and marketable skills and knowledge leading to a variety of employment opportunities within the design and wider associated engineering industries
- teaching and learning techniques which place emphasis on active and participative education
- the ability to apply modern technologies to solve various areas of engineering

C. Programme Objectives

After successful completion of the programme, students should be able to

- apply knowledge of mathematics, science modules and engineering
- design engineering system or process to meet specified performance, cost, time & safety
- identify, formulate and solve various electrical engineering problems
- apply knowledge to produce engineering solutions
- meet the expectations of the professional environment in relation to their intended careers

PART I - Regulations

D. General Entry Requirements

As per UTM'S Admission Regulations, and '*Admission to Programmes of Study at Degree Level*'.

E. Programme Entry Requirements

Holding an HSC in Mathematics or GCE in Mathematics at Advanced Level **and** one of the following subjects: Physics, Chemistry, Design and Technology, or any other applied science subject acceptable to the APL/APEL committee at HSC, GCE Advanced, or Baccalaureate Levels.

AND

Holding either a **Higher National Diploma (HND) in Instrumentation & Control Engineering** or a **Diploma in applied Electrical & Electronics Engineering** from the MITD;
a **Diplôme Universitaire Supérieur de Technologie (DUST) in Génie Électrique et Informatique Industrielle (GEII)** from the IST;
an **Advanced Technician Diploma** or **Full Technological Diploma in Electrical Engineering or Power Engineering or Electrical Technology** from the City and Guilds of London Institute;
or any other relevant and appropriate qualification pitched at **Level 6 of the MQA National Qualifications Framework**, acceptable to the APL/APEL committee.

F. Programme Mode and Duration

One Semester consists of 15 weeks (excluding exam period)

Full Time:	2.5 years (**5 Semesters**)
Part Time:	3.5 years (**7 Semesters**)

G. Teaching and Learning Strategies

- Lectures, Tutorial and Practical
- Tests and Assignments
- Workshops and Seminars
- The student would be expected to perform a substantial amount of self learning both for the theoretical and practical part of the modules.

H. Student Support and Guidance

- Academic tutoring: 2 hours per week per module
- Intensive tutoring conducted during Week 8 of the semester.

I. Attendance Requirements

As per UTM's Regulations and Policy.

J. Credit System

1 module = 3 or 6 credits
Final Year Project = 9 credits

K. Student Progress and Assessment

For the award of the degree, all modules must be passed overall with passes in the examinations, coursework and other forms of assessment. All modules will carry 100 marks and will be assessed as follows (*unless otherwise specified*):

(i) Written examinations inclusive reading time shall be of duration of 2-3 hours for 3-credit modules and not less than 3 hours for 4-credit modules and above.

(ii) Continuous assessment may vary up to a maximum of 100% of the total module marks. Continuous assessment can be based on a combination of assignments, field study, work-shops and class tests.

(iii) The overall pass mark for a module is 40%.Grading

Grade	*Marks x(%)*
A	$x \geq 70$
B	$60 \leq x < 70$
C	$50 \leq x < 60$
D	$40 \leq x < 50$
F	$x < 40$
A - D	Pass
F	Fail

L. Evaluation of Performance

The percentage mark at Level 3 contributes a 40% weighting towards the degree classification.
The percentage mark at Level 4 contributes a 60% weighting towards the degree classification.

The maximum marks attainable for each level are:

Level 3: 1200

Level 4: 1300

M. Award Classification

Overall weighted mark y (%)	Classification
$y \geq 70$	1st Class Honours
$60 \leq y < 70$	2nd Class 1st Division Honours
$50 \leq y < 60$	2nd Class 2nd Division Honours
$45 \leq y < 50$	3rd Class Honours
$40 \leq y < 45$	Pass Degree
$y < 40$	No Award

N. Programme Organisation and Management

Programme Director & Coordinator: Mr Rishi Heerasing

Contact Details:

- Room: G2.14
- Telephone Number: 207 5250
- Email: rheerasing@umail.utm.ac.mu

UTM-JSSA Liaison Officer: Dr V. Armoogum (varmoogum@utm.intnet.mu)

PART II - Programme Structure

O. BEng (Hons) Electrical Engineering (Top-Up) – Full Time (Version 2.3)

YEAR 1 (Level 3)							
Semester 1				**Semester 2**			
Code	**Modules**	**L+T/P+DS**	**Credits**	**Code**	**Modules**	**L+T/P+DS**	**Credits**
ASE1102	Material Science and Engineering **(Bridge module)**	2+1+0	3	MATH2147	Engineering Mathematics	2+1+0	3
MATH1201	Foundation Mathematics **(Bridge module)**	2+2+0	4	ELEC2201	Switchgear and Protection	2+1+0	3
ELEC1201	Engineering Principles and Measurements **(Bridge module)**	3+1+0	3	ELEC3102	Feedback Control	2+1+0	3
ELEC1202	Electric Power Generation **(Bridge module)**	2+1+0	3	ELEC3201	High Voltage Engineering	2+2+0	4
ELEC2202	Electrical Drawing & CAD	2+1+0	3	ELEC3202	Advanced Power Electronics	2+2+0	4
SEM3107	Project Management for Engineers **(Bridge module)**	2+1+0	3	ELEC3203	Transmission and Distribution	2+1+0	3

Inter Level Activity (at the end of Semester 2)			
Code	**Seminar**	**Hrs/Wk**	**Credits**
-	Research methods	12 hours (2-day workshop)	No credit, but Compulsory

YEAR 2 (Level 4)							
Semester 3				**Semester 4**			
Code	**Modules**	**L+T/P+DS**	**Credits**	**Code**	**Modules**	**L+T/P+DS**	**Credits**
MATH2148	Advanced Engineering Mathematics	2+2+0	4	PROJ4201	Industrial Attachment		3
ELEC3204	Electrical Machine Design	2+1+0	3	ELEC4203	Power System Planning	2+1+0	3
ELEC3205	DC and Synchronous Machines	2+2+0	4		Elective 1		3
ELEC3206	Power Systems Analysis and Stability	2+2+0	4				
ELEC3207	Signals and Systems	2+1+0	3	PROJ4113	Engineering Project		

YEAR 3 (Level 4)			
Semester 5			
Code	**Modules**	**L+T/P+DS**	**Credits**
ELEC4207	Power System Operation and Control	2+1+0	3
	Elective 2		3
PROJ4113	Engineering Project		9

P. BEng (Hons) Electrical Engineering (Top-Up) – Part Time (Version 2.3)

YEAR 1 (Level 3)							
	Semester 1				***Semester 2***		
Code	**Modules**	**L+T/P+DS**	**Credits**	**Code**	**Modules**	**L+T/P+DS**	**Credits**
ASE1102	*Material Science and Engineering* ***(Bridge module)***	*2+1+0*	*3*	*MATH2147*	*Engineering Mathematics*	*2+1+0*	*3*
MATH1201	*Foundation Mathematics* ***(Bridge module)***	*2+2+0*	*4*	*ELEC2201*	*Switchgear and Protection*	*2+1+0*	*3*
ELEC1201	*Engineering Principles and Measurements* ***(Bridge module)***	*3+1+0*	*3*	*ELEC2202*	*Electrical Drawing & CAD*	*2+1+0*	*3*
ELEC1202	*Electric Power Generation* ***(Bridge module)***	*2+1+0*	*3*	*SEM3107*	*Project Management for Engineers* ***(Bridge module)***	*2+1+0*	*3*

YEAR 2 (Level 3 & 4)							
	Semester 3				***Semester 4***		
Code	**Modules**	**L+T/P+DS**	**Credits**	**Code**	**Modules**	**L+T/P+DS**	**Credits**
MATH2147	*Engineering Mathematics*	*2+1+0*	*3*	*MATH2148*	*Advanced Engineering Mathematics*	*2+2+0*	*4*
ELEC2203	*Transmission and Distribution*	*2+1+0*	*3*	*ELEC2205*	*DC and Synchronous Machines*	*2+2+0*	*4*
ELEC2207	*Signals and Systems*	*2+1+0*	*3*	*ELEC2206*	*Power Systems Analysis and Stability*	*2+2+0*	*4*
ELEC3102	*Feedback Control*	*2+1+0*	*3*				

YEAR 3 (Levels 4)							
	Semester 5				***Semester 6***		
Code	**Modules**	**L+T/P+DS**	**Credits**	**Code**	**Modules**	**L+T/P+DS**	**Credits**
ELEC3201	*High Voltage Engineering*	*2+2+0*	*4*	*ELEC3202*	*Advanced Power Electronics*	*2+2+0*	*4*
PROJ4107	*Industrial Attachment*	*-*	*3*	*ELEC4203*	*Power System Planning*	*2+1+0*	*3*
	Elective 1		*3*				
PROJ4113	*Engineering Project*		*-*	*PROJ4113*	*Engineering Project*	*-*	

Inter Level Activity (at the end of Semester 5)			
Code	**Seminar**	**Hrs/Wk**	**Credits**
-	*Research methods*	*12 hours (2-day workshop)*	*No credit, but Compulsory*

YEAR 4 (Level 4)			
Semester 7			
Code	**Modules**	**L+T/P+DS**	**Credits**
ELEC4207	*Power System Operation and Control*	*2+1+0*	*3*
	Elective 2		*3*
PROJ4113	*Engineering Project*		*9*

List of Electives			
Code	**Modules**	**L+T/P+DS**	**Credits**
ELEC4204	*Industrial Management, Electrical Estimation & Economics*	*2+1+0*	*3*
ELEC4205	*Insulation Engineering*	*2+1+0*	*3*
ELEC4206	*Energy Auditing and Demand-Side Management*	*2+1+0*	*3*
ELEC4208	*PLC and SCADA*	*2+1+0*	*3*
ELEC4209	*Microprocessor*	*2+2+0*	*4*

Q. MODULE OUTLINE

ASE1102 - MATERIALS SCIENCE AND ENGINEERING (2+1+1) – BRIDGE MODULE
Materials science or engineering is an interdisciplinary field involving the properties of matter & its applications to various areas of science & engineering. Materials & their structures (metals, insulators & semiconductors), selected elements from periodic table, carrier transport: electrons & concepts of holes; density of elements. Composition of materials. Phase diagram sources. Thermodynamic & kinetic data (Bond strength; Melting point; solubility; heat of formation, fusion & sublimation; vapour pressure & diffusion). Thermal properties (conductivity & expansion). Mechanical properties (tensile, compressive, yield, flexural, shear & fatigue strength; materials hardness). Electrical properties (conductivity; resistivity; dissipation; dielectric strength; tangent loss). Optical properties (transmission range & dispersion; transparency & refractive index). Chemical properties (water absorption of polymers; galvanic series of metals; corrosion rate; flammability); Magnetic Materials, moment, magnetisation, field intensity, susceptibility. Diamagnetic, paramagnetic & ferromagnetic materials.

ELEC1201 - ENGINEERING PRINCIPLES AND MEASUREMENTS (3+1+0) – BRIDGE MODULE
Analysis of electrical circuits; Measurement of Resistance, Inductance, and Capacitance; Earth resistance measurement using Megger and by fall of potential methods; Resistive Networks; Ideal circuit elements; linear resistors; Ohms & Kirchoffs laws; Source transformations; Power matching; Thevenin and Norton theorems; Circuit Analysis; Energy storage Elements; Circuit analysis with time-dependent excitation; Steady behaviour of individual R, L and C elements to sinusoidal excitation; Transient Analysis: Step signals in RC and RL circuits: Anderson bridges; Sources and detectors; Extension of Instrument Ranges: Shunts and multipliers; Measurement of Power and Related Parameters; Measurement of real & reactive power in three-phase circuits; Induction type energy meter; Principle of working of electronic energy meter; Electronic Instruments; Transducers; Strain gauges; LVDT; Temperature measurements; Photo-conductive and photo-voltaic cells.

MATH1201 - FOUNDATION MATHEMATICS (2+2+0) – BRIDGE MODULE
Differentiation; Integration; Matrices; Vectors; Determinants; Complex numbers; Polar coordinates; Hyperbolic functions; Limits; Partial derivatives; First-order ordinary differential equations; Linear ordinary differential equations of second and higher order; Probability theory; Bayes' theorem; Random variables and distribution functions; Mathematical expectation and generating functions.

ELEC1202 - ELECTRIC POWER GENERATION (2+1+1) – BRIDGE MODULE
Sources of Electrical Power Stations; Hydro, Thermal & Nuclear; Substations; Grounding Systems.

MATH2147 – ENGINEERING MATHEMATICS
Matrix Algebra (Matrix operations, Solution of linear system of equations, Eigenvalues & vectors). Calculus (Logarithmic differentiation, Improper integrals). Fourier series & integrals (Periodic functions, Euler formulae, Fourier transforms, Linearity property, transform of derivatives, convolution theorem, Gamma, beta & Error functions). Boundary value problems & systems of ODEs. Multi-variable calculus (Partial & Directional derivatives, Maxima & minima). Solving mathematical / engineering problems using high-performance language for technical computing.

MATH2148 – ADVANCED ENGINEERING MATHEMATICS
Complex analysis (Functions of complex variables, Differentiation integration of complex functions, Line integrals in the complex plane). Integral transforms (Laplace transforms). Statistics (Probability density function, Distribution function of random variables, Joint density function of multivariate random functions. Sampling distributions. Estimation of variances (Hypotheses concerning one variance, Hypotheses concerning two variances). Solving engineering problems using high-performance language for technical computing.

ELEC2201 – SWITCHGEAR AND PROTECTION
Switches & fuses; Vacuum circuit breakers; Protective & Induction type relay; Protection Schemes.

ELEC2202 – ELECTRICAL DRAWING AND CAD
Single Line diagrams of stations & substations, layout of plants; Electrical Machine assembly drawings using design data & sketches; Winding Diagrams; Study of CAD graphics package.

ELEC3102 – FEEDBACK CONTROL
Control objectives & feedback systems. Transfer function description of dynamical systems; open loop, closed loop & error transfer functions. Laplace transforms & system response. Final Value theorem & steady state errors. Pole-Zero diagrams & Root Locus methods. Bode & Nyquist Diagrams. Stability, Hurwitz-Routh & simplified Nyquist criteria; Gain & phase margins. Introduction to PID, lead, lag & lead/lag controllers. Introduction to modern control methods.

SEM3107 - PROJECT MANAGEMENT FOR ENGINEERS (2+1+0) – BRIDGE MODULE
Project Management Fundamentals, Feasibility Study for large technical projects, Project Planning, Project organization, Techniques for Project Scheduling, Resource management, Risk management, Budgeting & Cost Management, Communications management, Procurement management, Project Monitoring, Managing technical people, Project Evaluation & Termination.

ELEC3201 – HIGH VOLTAGE ENGINEERING
Introduction; Breakdown phenomena; Generation of HV AC/DC; Generation of Impulse Voltage & Current; Measurement of HV; Non-destructive insulation testing techniques; High voltage tests on electrical apparatus. Over current relay**:** IDMT directional/non-directional characteristics for over & under voltage relay. Operation of negative sequence relay. Bias characteristics of differential relay. Current-time characteristics of fuse. Generator, Feeder, Motor protection scheme-fault studies. Spark over characteristics of air insulation subjected to HV AC with spark over voltage corrected to STP for uniform & non-uniform field configuration. Measurement of HV AC/DC using standard spheres.

ELEC3202 – ADVANCED POWER ELECTRONICS
DC-DC & DC-AC switched mode converters & inverters; Resonant converters; HF inductor & transformers; Power Supplies. Simulation using MATLAB/C/C++/Octave: Y Bus formation for p systems with & without mutual coupling; Determination of bus currents, bus power & line flow; Formation of Jacobian for systems not exceeding 4 buses in polar coordinates; Determine fault currents & voltages in a single transmission line system with star-delta transformers for SLGF, DLGF; Load flow analysis using Gauss-Siedel & NR methods, Fast decoupled flow method for pq & pv buses ; Optimal Generator Scheduling for Thermal power plants.

ELEC3203 – TRANSMISSION AND DISTRIBUTION
Typical transmission & distribution system scheme; Overhead transmission lines; Corona; Insulators; Underground cables; Performance of power transmission lines; Distribution.

ELEC3204 – ELECTRICAL MACHINE DESIGN
Principles of electrical machine design ; Design of DC machines ; Design of transformers ; Design of induction motors ; Design of synchronous machines.

ELEC3205 – DC MACHINES AND SYNCHRONOUS MACHINES
DC Generator ; DC Motors ; Losses & efficiency, Synchronous machines- Voltage Regulation Load characteristics of DC shunt & compound generator. Load test on a DC motor ; determination of speed-torque & HP-efficiency characteristics. Swinburne's Test, Hopkinson's Test, Fields test on series motors, Retardation test, Speed control of DC motor, Voltage regulation of alternators, Slip test, Performance of synchronous generator, V & Inverted-V curves of synchronous motor.

ELEC3206– POWER SYSTEM ANALYSIS & STABILITY
Representation of Power system Components ; Symmetrical 3-Phase faults, Symmetrical components ; Unsymmetrical faults ; Stability Studies

ELEC3207 – SIGNALS AND SYSTEMS
Introduction ; Time-domain representations for LTI systems ; Fourier representation of periodic signals ; The Continuous-Time Fourier Transform ; The Discrete-Time Fourier Transform ; Application of Fourier representations ; Z- Transforms.

ELEC4203 – POWER SYSTEM PLANNING
Intro to power planning; Generation planning; Computer-aided planning; Power supply reliability.

ELEC4204 – INDUSTRIAL MANAGEMENT, ELECTRICAL ESTIMATION & ECONOMICS
Personal management ; Production Management ; Economics of power factor improvement – Tariffs ; Interior wiring system ; Power installation.

ELEC4205 – INSULATION ENGINEERING
Electrostatic Field, their Control & Estimations ; Insulation system in power system apparatus ; Dielectric phenomena ; Properties of insulation materials ; Gaseous insulation ; Ageing phenomena

ELEC4206 – ENERGY AUDITING AND DEMAND SIDE MANAGEMENT
Introduction – Energy Economic Analysis ; Energy Auditing ; Electrical System Optimization ; Electrical Equipment & power factor ; Demand Side Management

ELEC4207 – POWER SYSTEM OPERATION AND CONTROL
Control center operation of power systems ; Automatic Generation Control ; Control of voltage & Reactive Power ; Power System Optimization ; Power System Security.

ELEC4208 – PLC AND SCADA
Introduction to Programmable Logic Controller operation, logic & Instructions; Timer And Counter Instructions, Introduction To Supervisory Control And Data Acquisition (SCADA).

ELEC4209 – MICROPROCESSOR
8086 Processors –Introduction, Instruction Set of 8086, Byte and String Manipulation, 8086 Interrupts And Interrupt Responses, 8086 Interfacing, Laboratory Experiments :- Programs on Data transfer instructions, Arithmetic & logical operation, Bit manipulation instructions, Branch/Loop instructions, Programs on String manipulation like string transfer, string reversing, searching for a string

PROJ4201 - INDUSTRIAL ATTACHMENT
Students will be attached to an ICT company or organization for a period of at least 15 weeks. Students will have the opportunity to apply theoretical knowledge to solve real world problems & to work within the organisational structure of the company. Students will have to complete a certain number of mini-projects (decided by the School) out of a list of areas. The list of areas will be provided to the students. This module is compulsory & is assessed by both UTM & external supervisors in a discussion panel. Students therefore have to perform satisfactorily in this module before qualifying for the award of the degree. An Industrial Attachment Handbook will be provided to the students.

RESEARCH METHODS (12 hours)
The importance of carrying out a proper literature review in the appropriate field will be emphasized. Students will be exposed to major sources of literature in the engineering field & they will be taught how to spot quality sources in their relevant fields. Different research methods will be presented to students. They will learn how to choose the appropriate research method for solving a research problem. The main data collection methods will be introduced. Students will be taught how to design questionnaires, prepare interviews & design experiments. Finally, students will be taught how to present, analyse & interpret their findings. Students should at the end of this module be able to prepare a research proposal for their programme.