MSc Electrical Engineering (Specialisation: Communication Engineering/ Control Systems / Power Systems - E532

1. Introduction

Electrical Engineering is a broad field of study encompassing Information and Communication Technologies, Control systems and Power systems, among others. Electrical Engineering is called nowadays to play a crucial role in the socio-economic development of Mauritius. With ongoing technological developments and the growing importance of research and development, there is an increasing need for post-graduates with specialization in Electrical Engineering in the above areas. Students will take taught core modules in their first year of study, and then specialize in either Communication Engineering, Control Systems or Power Systems in the second year, through taught elective modules and an MSc project.

2. Aims and Objectives

The MSc in Electrical Engineering programme is designed to provide instruction and training in the areas of communication engineering, control systems and power systems. The programme also aims at providing an adequate basis for those students who wish to subsequently pursue a career in research and or to undertake an MPhil/ PhD degree.

The Programme fulfils this aim by teaching students to:

a) understand and apply theory and practice of Communication Engineering, Control Systems and Power Systems

b) be able to analyse a particular communication, control or power system problem (depending on the field of specialisation) and use state of the art techniques to design and implement solution(s) to the problem; and

c) demonstrate critical and analytical thinking in the application of knowledge and/or research in a particular system.

3. General Entry Requirements

Successful completion of an undergraduate degree with

- at least a Second Class or 50%, whichever is applicable or
- a GPA not less than 2.5 out of 4 or equivalent, from a recognised higher education institution.

OR alternative qualifications acceptable to the University of Mauritius.

4. Programme Requirements

At least a second class degree in Electrical and Electronic Engineering, Electronic and Communciation Engineering, Information and Communication Technologies, Electronics and Computer Science, Mechatronics, Physics with Electronics, or any other Electrical Engineering related field from a recognised University. Preference will be given to candidates with at least two years of relevant work experience.

5. Programme Duration

The normal duration of the Programme will be 2 years with a maximum of 4 years (8 semesters) subject to the approval of the Faculty. However, students wishing to exit before the end of the course may do so as follows:

(a) After successfully completing **five (5)** modules for the award of a **Postgraduate Certificate**.
(b) After successful completion of **nine (9)** modules, for the award of a **Postgraduate Diploma**.

6. Credits per Semester

Minimum 3 credits subject to Regulation 5 and a maximum of 3 taught modules.

7. Minimum Credits Required for the Award of

Master's Degree:	36
Postgraduate Diploma:	27
Postgraduate Certificate:	15

Breakdown as follows:

	Minimum Core Taught Modules	**Project**	**Electives/ Optional Modules**
Master's Degree:	18 credits	9 credits	9 credits
Postgraduate Diploma:	18 credits		9 credits
Postgraduate Certificate:	15 credits		

8. Assessment

Each module will carry 100 marks and will be assessed as follows (unless otherwise specified):

Assessment will be based on a written examination of 3 hours and continuous assessment carrying a range of 10% to 30% of total marks. Continuous assessment may be based on laboratory works, and/or assignments and should include at least one class test.

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.

9. Plan of Study

Students are required to submit at the end of Semester 1, a Plan of Study for their whole Programme of Studies, indicating the list of elective modules and in which semester each of them will be taken.

Students should indicate their respective area of specialization in either (a) Communication Engineering, or (b) Control Engineering or (c) Power Systems, before being allowed to register for elective modules and the MSc project.

The University reserves the right not to offer a given elective module if the critical number of students is not attained and/or for reasons of resource constraints.

10. List of Modules

CORE MODULES

	Module	Hrs/Wk L+P	Credits
ELEC 6101	Instrumentation and Measurements	3+0	3
ELEC 6102	Analytical Techniques	3+0	3
ELEC 6103	Advanced Signal Processing	3+0	3
ELEC 6201	Communication Engineering	3+0	3
ELEC 6202	Control Systems	3+0	3
ELEC 6203	Power Systems	3+0	3
ELEC 6000	Project	-	9

ELECTIVES

Communication Engineering Stream

ELEC 6301	Mobile Communications and Wireless Technologies	3+0	3
ELEC 6302	RF and Microwave Design for Wireless Systems	3+0	3
ELEC 6303	Satellite Communications	3+0	3
ELEC 6401	Telecommunication Networks	3+0	3
ELEC 6402	Applied Information Theory and Coding	3+0	3
ELEC 6407	Broadcasting Technologies	3+0	3

Control Systems Stream

ELEC 6304	Advanced Control Systems	3+0	3
ELEC 6305	Modern Control Engineering	3+0	3
ELEC 6306	Optimal Control	3+0	3
ELEC 6403	Power Electronics and Motor drives	3+0	3
ELEC 6404	Digital Control	3+0	3

Power Systems Stream

ELEC 6307	Power Systems Optimization	3+0	3
ELEC 6308	Power System Dynamics and Stability	3+0	3
ELEC 6309	Power System Reliability	3+0	3
ELEC 6310	High Voltage Engineering	3+0	3
ELEC 6405	Power Station Design	3+0	3
ELEC 6406	Intelligent Tools for Power Systems	3+0	3

11. Programme Plan - MSc Electrical Engineering (Specialisation: Communication Engineering /Control Systems/ Power Systems)

YEAR 1							
Semester 1				Semester 2			
Code	Module	Hrs/Wk L+P	Credits	Code	Module	Hrs/Wk L+P	Credits
CORE				CORE			
ELEC 6101	Instrumentation and Measurements	3+0	3	ELEC 6201	Communication Engineering	3+0	3
ELEC 6102	Analytical Techniques	3+0	3	ELEC 6202	Control Systems	3+0	3
ELEC 6103	Advanced Signal Processing	3+0	3	ELEC 6203	Power Systems	3+0	3

YEAR 2							
Semester 3				Semester 4			
Code	Module	Hrs/Wk L+P	Credits	Code	Module	Hrs/Wk L+P	Credits
CORE				CORE			
ELEC 6000	Project	-	-	ELEC 6000	Project	-	9
ELECTIVES							
(a) Communication Engineering stream							
ELEC 6301	Mobile Communications and Wireless Technologies	3+0	3	ELEC 6401	Telecommunication Networks	3+0	3
ELEC 6302	RF and Microwave design for wireless systems	3+0	3	ELEC 6402	Applied Information Theory and Coding	3+0	3
ELEC 6303	Satellite Communication	3+0	3	ELEC 6407	Broadcasting Technologies	3+0	3
(b) Control Systems stream							
ELEC 6304	Advanced Control Systems	3+0	3	ELEC 6403	Power Electronics and Motor Drives	3+0	3
ELEC 6305	Modern Control Engineering	3+0	3	ELEC 6404	Digital Control	3+0	3
ELEC 6306	Optimal Control	3+0	3				
(c) Power Systems stream							
ELEC 6307	Power Systems Optimisation	3+0	3	ELEC 6405	Power Station Design	3+0	3
ELEC 6308	Power Systems Dynamics and Stability	3+0	3	ELEC 6406	Intelligent Tools for Power Systems	3+0	3
ELEC 6309	Power System Reliability	3+0	3				
ELEC 6310	High Voltage Engineering	3+0	3				

Note 1: A limited number of seats will be available for each stream.

Note 2: Students will opt for a field of specialization before being allowed to register for Semester 3 electives and the MSc project. Once a stream has been selected, students will not be allowed to change stream up to the completion of the Programme of Studies.

Note 3: Students are required to register at the Faculty for modules that they intend to follow in a given semester on a date specified by the Faculty. However, students will be allowed to withdraw from a module without penalty within 4 weeks from the first day of the semester.

Note 4:An elective will be provided only if sufficient number of students have opted for it and depending on availability of resource persons.

Note 5: In order to be allowed to register on the project, students must clear at least four (4) Core modules in Semesters 1 & 2.

12. Outline Syllabus

CORE MODULES

ELEC 6101 - INSTRUMENTATION AND MEASUREMENTS (L/P-3+0, Credits-3)
Introduction to Transducers, Transducer Signal Conditioning, Temperature transducers, Displacement transducers, Optical transducers, Flow transducers, Errors. Remote sensing, Image processing and segmentation. Non-destructive evaluation & testing. Tomographic techniques, Radar Techniques & Doppler Effects.

ELEC 6102 - ANALYTICAL TECHNIQUES (L/P-3+0, Credits-3)
Differential equations: solutions of 1^{st}, 2^{nd} and higher order differential equations, transient and forced responses; Laplace Transforms: s-domain analysis of a continuous time system, derivation of the transfer function; Linear algebra: vector spaces, vector, matrices, determinants and elementary matrix operations, norms, eigenvalues, eigenvectors, spectral radius, condition number of a matrix; Probability and statistics: Baye's Theorem, Discrete and continuous random variables, Probability density functions (PDF), Cumulative distribution functions (CDF), The Central Limit Theorem, T-distributions, Estimation and Hypothesis testing

ELEC 6103 - ADVANCED SIGNAL PROCESSING (L/P-3+0, Credits-3)
Discrete-time signals and systems, impulse response and convolution, frequency response, Z-transform, random signals, autocorrelation and cross-correlation, MA and AR processes, prediction, DTFT, DFS, DFT, FFT, filter specifications, filter structures, IIR filter design, FIR, filter design, multi-rate DSP, sampling rate conversions and applications, C/D and D/C conversions, practical DSP, DSP applications.

ELEC 6201 - COMMUNICATION ENGINEERING (L/P-3+0, Credits-3)
Information theory, source coding, channel coding, baseband transmission, bandpass modulation and demodulation, error performance for binary systems, communication link analysis, satellite communication, multiplexing and multiple access techniques, spread spectrum techniques, Optical fibre communications.

ELEC 6202 - CONTROL SYSTEMS (L/P-3+0, Credits-3)
Introduction, Modeling in the time-domain and in the frequency domain, Time Response, Reduction of Multiple subsystems, Stability, Steady-state errors, Root-Locus techniques, Design via Root-Locus, Frequency response techniques, Design via Frequency Response, Nonlinear Models and Simulation.

ELEC 6203 - POWER SYSTEMS (L/P-3+0, Credits-3)
Economic dispatch, Unit commitment, Load flow studies, Fault analysis, Power system stability, Power system security, State estimation.

ELEC 6000 - PROJECT
Objectives:
1. To develop an ability to undertake research analysis, design, simulation and/or implementation given an appropriate level of supervision;
2. To develop objectives and program of work;
3. To collect information, assess it and present it in an orderly and coherent form; and
4. To be able to work a document, which presents clearly findings, related to the study.

ELECTIVE MODULES

ELEC 6301 - MOBILE COMMUNICATIONS AND WIRELESS TECH. (L/P-3+0, Credits-3)
Inverse Fourth power, shadowing and Rayleigh fading losses, Narrow band system performance, Wide band system principles, Multiple access techniques for wireless communications, GSM system, UMTS, wireless technologies, Benefits of wireless Communications benefits, point to multipoint and multipoint to multipoint links,wireless data network, WIFI.

ELEC 6302 - RF & MICROWAVE DESIGN FOR WIRELESS SYSTEMS (L/P-3+0, Credits-3)
Introduction to microwave communication systems; link budget; RF subsystems; system modelling; modulation formats and impact on circuit design; distortion and spectral regrowth; direct and heterodyne conversion; sub-system characterisation; system noise figure analysis; impact of RF/microwave component design on wireless communication system performance; microwave and RF filter design.

ELEC 6303 - SATELLITE COMMUNICATION (L/P-3+0, Credits-3)
Satellite link design, orbit description, coverage angle and slant range, placement of a satellite in a geostationary orbit, interference analysis, rain reduced attenuation, modulation and multiplexing techniques for satellite links.

ELEC 6401 - TELECOMMUNICATION NETWORKS (L/P-3+0, Credits-3)
Introduction to general networking; Structure of the telecommunications network; Network topologies, Data Communications, Layered architectures in data networks; Unslotted and slotted ALOHA; CSMA systems, including non-persistent, p-persistent CSMA/CD; Routing and addressing, Multimedia Networking, Quality of Service. The IEEE 802 protocols, Ethernet, token bus and token ring systems; Local area networks (LANs), WANs and MANs; Introduction to wireless networks; Intelligent networks. Computer networks, Mobile networks (GSM), Packet Radio networks, Internetworking, VoIP networks, X25 and Switching Techniques.

ELEC 6402 - APPLIED INFORMATION THEORY AND CODING (L/P-3+0, Credits-3)
Definitions of information and entropy. Source coding: Scalar quantisation, Predictive coding, LPC, vector quantisation, speech compression, sub-band coding; Entropy coding, Rate distortion theory; Channel coding and theorems, Turbo codes, Gallager codes, LDPC codes, convolutional codes, block codes, BCH, RS codes, Joint source and channel coding; Other Applications of Information Theory.

ELEC 6407 - BROADCASTING TECHNOLOGIES (L/P-3+0, Credits-3)
Sound
Conventional FM Broadcasting, MPEG and MP3 audio layers, Digital Audio Broadcasting (DAB) techniques.
Television
Analog TV transmission (PAL, NTSC, SECAM), NICAM Audio, MPEG transmission layer, orthogonal Frequency Division Multiplexing (OFDM), Digital Terrestrial TV Broadcasting (DTTB) techniques (DVB-T, ISDB, ATSC), Single Frequency Networking (SFN), Digital Satellite TV Broadcasting (DVB-S and ISDB), Digital Cable TV transmission.
New Developments in Television Broadcasting
Interactive TV, 3D-TV, Teletext, Data Services.

ELEC 6304 - ADVANCED CONTROL SYSTEMS (L/P-3+0, Credits-3)
Introduction to Multivariable control, Limitations on Performance in SISO systems and in MIMO systems, Uncertainty and Robustness for SISO systems, Analysis of Nonlinear Control Systems, Phase-plane analysis, Lyapunov stability analysis, Adaptive Control Systems, Model Predictive Control, Gain-scheduled control.

ELEC 6305 - MODERN CONTROL ENGINEERING (L/P-3+0, Credits-3)
Introduction, Simulation & Modeling, Linear Systems Theory, Specifications and Limitations, Introduction to H^{∞} theory, Nyquist criterion, Classical design, State feedback, State-Space Analysis of Control Systems, State-Space Design.

ELEC 6306 - OPTIMAL CONTROL (L/P-3+0, Credits-3)
Performance measures for optimal control problems, Dynamic programming, Calculus of variations and Pontryagin's minimum principle,Variational approach to optimal control problems, Design of optimal regulators and tracking systems.

ELEC 6403 - POWER ELECTRONICS AND MOTOR DRIVES (L/P-3+0, Credits-3)
Switch mode Voltage Source and Current Regulated Dc to Ac inverters, Constant V/Hz Control of 3-phase induction motor, Vector controlled ac drives, Direct torque Control, Electronically Commutated Brushless

Dc Motor Drives and control. Power Processing Units for Stepper motor and Switch Reluctance drives. Design of speed and position controllers.

ELEC 6404 - DIGITAL CONTROL (L/P-3+0, Credits-3)
Review of difference equations and z-transforms. Modelling ADC, Effects of sampling, DAC modelling and extrapolations, Modelling of sampled process, Performance of sampled data systems: mapping characteristics, transient response, steady state error and stability analysis, Digital equivalent of continuous controllers, Discrete time root locus, w-plane design of digital controllers, state feedback, state estimator and dead-beat design.

ELEC 6307 - POWER SYSTEMS OPTIMIZATION (L/P-3+0, Credits-3)
Electric power system models, Power-flow computations, Constrained optimization and applications, Linear programming and applications, Interior point methods, Nonlinear programming, Dynamic programming, Lagrangian relaxation, Decomposition method, Optimal power flow, Unit commitment.

ELEC 6308 - POWER SYSTEM DYNAMICS AND STABILITY (L/P-3+0, Credits-3)
General characteristics of modern power systems, Power system stability problem, Synchronous machine theory and modeling, Excitation systems, Prime movers and energy supply systems, Control of active power and reactive power, Small-signal stability, Transient stability, Voltage stability, Methods of improving stability.

ELEC 6309 - POWER SYSTEM RELIABILITY (L/P-3+0, Credits-3)
Probability theory, Reliability concepts, Static generating capacity reliability evaluation, Spinning generating capacity reliability evaluation, Transmission system reliability evaluation, Composite system reliability evaluation, Interconnected system generating capacity reliability evaluation.

ELEC 6310 - HIGH VOLTAGE ENGINEERING (L/P-3+0, Credits-3)
Generation of high voltages, Measurement of high voltages, Electrostatic fields and field stress control, Electrical breakdown in gases, Breakdown in solid and liquid dielectrics, Non-destructive insulation test techniques, Overvoltages, testing procedures and insulation coordination, Design and testing of external insulation.

ELEC 6405 - POWER STATION DESIGN (L/P-3+0, Credits-3)
Load prediction, Selection of power stations and units, Diesel-electric stations, Steam stations, Gas turbine stations, Hydro-electric stations, Major electrical plant in power stations, Power station control and interconnection, Protective relaying for power stations, Economic loading of power stations.

ELEC 6406 - INTELLIGENT TOOLS FOR POWER SYSTEMS (L/P-3+0, Credits-3)
Expert systems, Fuzzy logic, Neural networks, Genetic algorithms, Applications in: alarm processing, fault diagnosis in power systems, reactive power and voltage control, stability control for power systems, generation scheduling, electrical load forecasting, power system static security assessment.