



UNIVERSITY  
of  
TECHNOLOGY,  
MAURITIUS

**School of Innovative Technologies Engineering**

**Department of Industrial Systems Engineering**

# **BEng (Hons) Telecommunication Engineering**

**PROGRAMME DOCUMENT**

VERSION 1.6  
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## **BENG (HONS) TELECOMMUNICATION ENGINEERING**

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### **A. PROGRAMME INFORMATION**

This programme is designed to integrate telecommunication systems with computer technology so that graduates can take up demanding, responsible and exciting positions in the rapidly expanding telecommunication industries. The programme has been developed in consultation with leading telecommunications companies in Mauritius and is tailored to the current needs of industry. Armed with this qualification, graduates will have a sound knowledge on programming techniques, on telecommunication and network technologies, on digital and analogue technologies, on legal issues and on standards used. Graduates will also have the necessary skills to develop a concept through the design and computer modeling stages.

The growth of telecommunications over the last ten years has been phenomenal and this expansion is set to continue for several decades. Computer networks, radio links and optical fibre systems are all being developed and now form the basis for global communications. The internet is the largest technological machine in the world with an enabling capability which affects us all, ranging from email, worldwide access to information and distributed computing, through to electronic marketing and commerce.

In first level the programme covers a broad range of fundamental concepts in telecommunication and electronics, of applied mathematics, of materials science and engineering, and of programming topics, and lays the theoretical and practical foundations for study at a more advanced level.

In second and third level the modules are built to give the students an understanding of how to apply basic principles to more complex problems and helping them to develop sophisticated analysis methods and design. Hence, the work becomes more specialised with core modules such as Switching Techniques, Antenna and Radio Wave Propagation, Wireless Communications, Mobile Communication Engineering, Microwave Engineering, IP Telephony, Digital Signal Processing, RF Systems and Design and Telecommunications Standards

The last level deals with elective modules such as VLSI design and Technology, Satellite Communication systems and Optical fibre Communication systems. These modules deal with the details of how and why telecommunication systems work. Moreover, in the last level, students will be attached to industries for one full semester so that they can apply their theoretical knowledge to solve real world problems in Telecommunication and Electronic Engineering. The student will have to complete a final year project to be qualified for the BEng programme.

### **APPROVAL OF CURRICULUM**

The BEng (Hons) Telecommunication Engineering programme meets the academic requirements set by the **Council of Registered Professional Engineers (CRPE)** of Mauritius.

### **B. PROGRAMME AIMS**

The BEng (Hons) Telecommunication Engineering programme aims to provide a foundation upon which you can build a successful career. This programme has been created to provide you with the skills and abilities required by telecommunications companies. The programme deals with telecommunications engineering as well as electronics.

#### **Employment Prospects**

There are many and varied career opportunities for highly qualified engineers in the telecommunications industries. These industries are large and strong in Mauritius and in the region. Also, due to the global nature of telecommunications there are also career opportunities in other part of the World. This programme has much in common with undergraduate programme in Electronic and related, meaning graduates have a great deal of flexibility and could easily apply for posts in telecommunications companies as well as electronics companies. As well as more general management and applications opportunities, possible employment areas include Telecommunications engineering, Mobile network field staff, Telecommunications network support staff, Technical management, Network planning and implementation, Network management and Research and development.

In addition, there are openings in education, in both teaching and research. The solid base that the programme provides can lead to research work either through an MEng programme or to study for a PhD.

## **C. PROGRAMME OBJECTIVES**

After successful completion of the BEng programme, the graduates should

- achieve the knowledge and understanding of mathematical and scientific principles to underpin their education in telecommunication engineering and to apply mathematical methods, tools and notations proficiently in the analysis and solution of engineering problems;
- achieve the understanding of engineering principles and the ability to apply them to analyse key engineering processes;
- develop the ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques;
- develop the ability to apply quantitative methods and computer software in order to solve engineering problems;
- be able to create and develop economically viable products, processes or systems to meet a defined need;
- acquire knowledge of management techniques which may be used to achieve engineering objectives;
- acquire knowledge of relevant legal requirements governing engineering activities, including personnel, health, safety and risk;
- achieve the understanding of the need for a high level of professional and ethical conduct in engineering;
- 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.

## **PART I REGULATIONS**

### **D. GENERAL ENTRY REQUIREMENTS**

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

### **E. PROGRAMME ENTRY REQUIREMENTS**

'A' Level in Mathematics and one subject from Physics, Chemistry, Physics with Chemistry, Electronics, Computer Studies, Design and Technology, or any other applied science subject acceptable to APL/APEL committee at HSC, GCE "A" Level, or Baccalaureate, or alternatively holding an Advanced or Higher Technician Diploma, or the Brevet de Technicien Superieur of the Mauritius Institute of Training and Development / Industrial and Vocational Training Board (Mauritius), or the Full Technological Certificate of the City and Guilds of London Institute, or an alternative diploma acceptable to APL/APEL committee.

### **F. PROGRAMME MODE AND DURATION**

Full Time: Minimum 4 years (8 semesters) and Maximum 7 years (14 semesters)

Part Time: Minimum 6 years (12 semesters) and Maximum 9 years (18 semesters)

### **G. TEACHING AND LEARNING STRATEGIES**

- Lectures, Tutorials and Practical
- Class Tests and Assignments
- Professional Work Placement
- Workshops / Seminars / Lab Sessions
- Structured Discussions & Self Directed Study
- Case Study materials & scenarios centred on real world problems

### **H. STUDENT SUPPORT AND GUIDANCE**

- Student counseling
- Supervision

### **I. ATTENDANCE REQUIREMENTS**

As per UTM's Regulations and Policy.

### **J. CREDIT SYSTEM**

1 module = 3/4/8 credits

### **K. STUDENT PROGRESS AND ASSESSMENT**

The course is delivered through lectures and seminars, and computer and practical sessions in computer and engineering labs. Self-study is also important and will include reading, designing and preparing presentations, writing reports and theses, and investigating problems.

The importance of IT/simulation tools in modern telecommunication engineering practice is emphasised, and students will make use of the latest software to solve mathematical, control and signal-processing problems and to prepare electronic and systems designs.

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

1. Written and/or practical examination, and continuous assessment carrying up to 50% of total marks.
2. The following modules will be assessed by 100% coursework: 'Communication workshop' and 'Research methodology'. The coursework must consist of at least one class test and two assignments.
3. The continuous assessment for all four-credit modules will carry a weightage varying between 40% and 50%. The coursework must consist of at least one class test and one assignment.
4. The continuous assessment for all three-credit modules will carry a weightage of 30%. The coursework must consist of at least one class test and one assignment.

The final dissertation/project will carry 300 marks (9 credits)

**Maximum marks attainable:**

Level 1	1200
Level 2	1200
Level 3	1200
Level 4	700

**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**

- (i) The % mark at Level 1 contributes a 20% weighting towards the degree classification.
- (ii) The % mark at Level 2 contributes a 20% weighting towards the degree classification.
- (iii) The % mark at Level 3 contributes a 30% weighting towards the degree classification.
- (iv) The % mark at Level 4 contributes a 30% weighting towards the degree classification.

**M. AWARD CLASSIFICATION**

**Overall weighted mark y (%)**

$y \geq 70$
$60 \leq y < 70$
$50 \leq y < 60$
$45 \leq y < 50$
$40 \leq y < 45$
$y < 40$

**Classification**

1st Class Honours
2 <sup>nd</sup> Class 1st Division Honours
2 <sup>nd</sup> Class 2 <sup>nd</sup> Division Honours
3rd Class Honours
Pass Degree
No Award

**N. PROGRAMME ORGANISATION AND MANAGEMENT**

**Programme Director/Coordinator:** Dr. Vinaye ARMOOGUM

**Contact Details :** Tel: 207-5250 Fax: 234-1767

**Email:** [varmoogum@umail.utm.ac.mu](mailto:varmoogum@umail.utm.ac.mu)

**PART II**

**O. PROGRAMME STRUCTURE (Full-Time)**

**BENG (HONS) TELECOMMUNICATION ENGINEERING**

<b>YEAR 1 (Level 1)</b>							
<b>Semester 1</b>				<b>Semester 2</b>			
<b>Code</b>	<b>Modules</b>	<b>Hrs/Wk L T/P</b>	<b>Credits</b>	<b>Code</b>	<b>Modules</b>	<b>Hrs/Wk L T/P</b>	<b>Credits</b>
TELC1101	Communications Systems Fundamentals	2+1	3	ELEC1102	Analogue Electronics	2+2	4
ASE1101	Principles of Engineering	2+1	3	ASE1102	Materials Science and Engineering	2+1	3
PROG1114	Programming for Engineers	2+2	4	PROG1114	Programming for Engineers	2+2	4
MATH1145	Foundation Mathematics	2+2	4	HCA1109	Computer and Microprocessor Architecture and Programming	2+2	4
ITE1104	Legal Issues & Professional Ethics for Engineers	2+1	3	CAN1102	Networks	2+1	3
COMM1106	Communication Workshop	2+1	3	MATH1146	Numbers, Logics and Graphs Theories	2+2	4

<b>YEAR 2 (Level 2)</b>							
<b>Semester 1</b>				<b>Semester 2</b>			
<b>Code</b>	<b>Modules</b>	<b>Hrs/Wk L T/P</b>	<b>Credits</b>	<b>Code</b>	<b>Modules</b>	<b>Hrs/Wk L T/P</b>	<b>Credits</b>
ASE2101	Health, Safety and Risk in Engineering	2+1	3	CAN2113	Switching Techniques	2+2	4
ELEC2103	Digital Electronics	2+2	4	TELC2104	Antennas and Radio Wave Propagation	2+2	4
OSS2108	Network Operating System	2+2	4	ASE2103	Electromagnetic theory	2+1	3
TELC2103	Wireless Communications	2+2	4	TELC2103	Wireless Communications	2+2	4
SCG2123	Digital Signal Processing	2+2	4	SCG2123	Digital Signal Processing	2+2	4
MATH2147	Engineering Mathematics	2+2	4	MATH2148	Advanced Engineering Mathematics	2+2	4

**YEAR 3 (Level 3)**

<b>YEAR 3 (Level 3)</b>							
<b>Semester 1</b>				<b>Semester 2</b>			
<b>Code</b>	<b>Modules</b>	<b>Hrs/Wk L T/P</b>	<b>Credits</b>	<b>Code</b>	<b>Modules</b>	<b>Hrs/Wk L T/P</b>	<b>Credits</b>
TELC3111	RF Systems and Design	2+2	4	ASE3101	Research Methodology	2+1	3
TELC3106	Microwave Engineering	2+2	4	TELC3106	Microwave Engineering	2+2	4
HCA3110	Embedded Systems and Design	2+2	4	HCA3110	Embedded Systems and Design	2+2	4
TELC3107	IP Telephony	2+2	4	TELC3109	Telecommunications standards, regulation and legislation	2+1	3
TELC3108	Mobile Communication Engineering	2+2	4	TELC3110	Electromagnetic Compatibility	2+1	3
MATH3149	Scientific Computing	2+2	4	SEM3107	Project Management for Engineers	2+1	3

**YEAR 4 (Level 4)**

<b>YEAR 4 (Level 4)</b>						
<b>Semester 1</b>				<b>Semester 2</b>		
<b>Code</b>	<b>Modules</b>	<b>Hrs/Wk L T/P</b>	<b>Credits</b>	<b>Modules</b>	<b>Hrs/Wk L T/P SS</b>	<b>Credits</b>
PROJ4201	Professional Work Placement	-	3	Elective 1	-	3
SECU4114	Security in Telecommunications	2+2	4	Elective 2	-	3
PROJ4112	Telecom Project		-	Telecom Project		9

**P. PROGRAMME STRUCTURE (Part-Time)**

**BENG (HONS) TELECOMMUNICATION ENGINEERING**

YEAR 1							
Semester 1				Semester 2			
Code	Modules	Hrs/Wk L T/P	Credits	Code	Modules	Hrs/Wk L T/P	Credits
TELC1101	Communications Systems Fundamentals	2+1	3	ASE1102	Materials Science and Engineering	2+1	3
ASE1101	Principles of Engineering	2+1	3	COMM1106	Communication Workshop	2+1	3
PROG1114	Programming for Engineers	2+2	4	PROG1114	Programming for Engineers	2+2	4
MATH1145	Foundation Mathematics	2+2	4	CAN1102	Networks	2+1	3
→ Start of Level 1							

YEAR 2							
Semester 1				Semester 2			
Code	Modules	Hrs/Wk L T/P	Credits	Code	Modules	Hrs/Wk L T/P SS	Credits
HCA1109	Computer and Microprocessor Architecture and Programming	2+2	4	ASE2101	Health, Safety and Risk in Engineering	2+1	3
ELEC1102	Analogue Electronics	2+2	4	ELEC2103	Digital Electronics	2+2	4
ITE1104	Legal Issues & Professional Ethics for Engineers	2+1	3	OSS2108	Network Operating Systems	2+2	4
MATH1146	Numbers, Logics and Graphs Theories	2+2	4	CAN2113	Switching Techniques	2+2	4
End of Level 1 →				→ Start of Level 2			

YEAR 3							
Semester 1				Semester 2			
Code	Modules	Hrs/Wk L T/P	Credits	Code	Modules	Hrs/Wk L T/P	Credits
TELC2104	Antennas and Radio Wave Propagation	2+2	4	ASE2103	Electromagnetic theory	2+1	3
TELC2103	Wireless Communications	2+2	4	TELC2103	Wireless Communications	2+2	4
SCG2123	Digital Signal Processing	2+2	4	SCG2123	Digital Signal Processing	2+2	4
MATH2147	Engineering Mathematics	2+2	4	MATH2148	Advanced Engineering Mathematics	2+2	4
End of Level 2 →							



YEAR 4							
Semester 1				Semester 2			
Code	Modules	Hrs/Wk L T/P	Credits	Code	Modules	Hrs/Wk L T/P	Credits
TELC3111	RF Systems and Design	2+2	4	ASE3101	Research Methodology	2+1	3
TELC3107	IP Telephony	2+2	4	TELC3109	Telecommunications standards, regulation and legislation	2+1	3
TELC3110	Electromagnetic Compatibility	2+1	3	TELC3106	Microwave Engineering	2+2	4
MATH3149	Scientific Computing	2+2	4	HCA3110	Embedded Systems and Design	2+2	4
→ Start of Level 3							

YEAR 5							
Semester 1				Semester 2			
Code	Modules	Hrs/Wk L T/P	Credits	Code	Modules	Hrs/Wk L T/P	Credits
TELC3108	Mobile Communication Engineering	2+2	4	PROJ4201	Professional Work Placement	-	3
TELC3106	Microwave Engineering	2+2	4	SECU4114	Security in Telecommunications	2+2	4
HCA3110	Embedded Systems and Design	2+2	4				
SEM3107	Project Management for Engineers	2+1	3	PROJ4112	Telecom Project		-
End of Level 3 →				→ Start of Level 4			

YEAR 6							
Semester 1				Semester 2			
Code	Modules	Hrs/Wk L T/P	Credits	Code	Modules	Hrs/Wk L T/P	Credits
	<i>Elective 1</i>	-	3		<i>Elective 2</i>	-	3
PROJ4112	<i>Telecom Project</i>		-	PROJ4112	<i>Telecom Project</i>		9
End of Level 4 →							

<b>Electives</b>			
<b>Code</b>	<b>Modules</b>	<b>Hrs/Wk</b> L T/P	<b>Credits</b>
ELEC4104	VLSI Design and Technology	2+1	3
TELC4111	Satellite communication systems	2+1	3
TELC4112	Optical fibre communication systems	2+1	3
SEM4107	Quality assurance and management principles	2+1	3
TELC4113	Broadband Communications	2+1	3
CAN2103	Communication & Networking- Design and Management	2+1	3
TELC4114	Radio/Television Broadcasting Technology	2+1	3
TELC4115	Telecommunication and Networking In Business	2+1	3
TELC4116	Cloud Systems Engineering	2+1	3

## **Q. MODULE OUTLINE**

### **TELC1102: COMMUNICATIONS SYSTEMS FUNDAMENTALS (2+1)**

The communications channel, baseband transmission, digital modulation, transmission, impairments. Radio wave propagation. Aerial design. Radio frequency, signal generation and detection. Transmitter and receiver circuits. Computers and devices, Networks and Network Operating systems. Scientific programming languages and simulators, Wireless Communications (Cellular, Satellite communications etc). Digital radio systems. Standards.

### **ASE1101: PRINCIPLES OF ENGINEERING (3+1)**

Mechanical and electrical systems and applications; electric circuits and applications; Analysis of electrical circuits; Resistive Networks: Ideal circuit elements; linear resistors; Ohms Law, Kirchoff's law / Source transformations; Power matching; Thevenin and Norton theorems; Nodal and loop method of analysis; Energy Storage Elements: Transition from electromagnetic and electrostatic ideas to the linear capacitor and inductor, input and output impedances, phase, Db; Maximum available power, 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; Energy calculations; Other elements of natural sciences.

### **PROG1114: PROGRAMMING FOR ENGINEERS (2+2 RUN ON 2 SEMESTERS)**

Basic I/O, Basic data types. Sequence, selection and iteration, Use of control graph. Introduction to procedural programming, Use of call graph. Implementation of simple algorithms. Elementary code inspection and testing. Fundamental quality attributes of code. Introduction to professional programming conventions and protocols. Implementation using abstract structures, referential data types. Use of file I/O. Implementation of a few complex algorithms/ data structures. Introduction to OOP paradigm: Class, object, association, inheritance, polymorphism. Programming workshops in C++ or Java JDK. Implementation of generic data structures in OOP (stack, linked lists etc). Use of Objects in ADT. Testing of OO code. Quality attributes of OO code.

### **MATH1145: FOUNDATION MATHEMATICS (2+2)**

Functions and coordinate geometry (Types of functions, Composite functions, Inverse functions, Modelling of periodic phenomena with trigonometric functions). Introducing MATLAB. Complex numbers (Differentiation and Integration, Applications to related rate of change and optimization problems, Integration by parts). Vector Algebra and Geometry (2D and 3D vectors, Equations of lines and planes, Application to motion and kinematics). Sequences and series (Convergence, Power series, Taylor polynomials, Ordinary differential equations). Solving mathematical / engineering problems using high-performance languages (e.g. MATLAB).

### **ITE1104: LEGAL ISSUES & PROFESSIONAL ETHICS FOR ENGINEERS (2+1)**

Philosophical Foundations of Scientific Ethics, Legal & Ethical principles guiding the development of telecommunications and Engineering, Public accountability and transparency, Capacity building on ethical Issues, Media outreach on ethical issues, International cooperation, Patenting Rights and Issues, Business ethics and corporate social responsibility, Ethical Standards for Engineers and Telecoms industry, Ethical Problems and Dilemmas in the Interaction between Science and Media, The Ethics of Collecting and Processing Data and Publishing Results of Scientific Research, Integrity and Misconduct in Research & Development, Legal Aspects of Academic Dishonesty, Professional Ethics

### **COMM1106: COMMUNICATION WORKSHOP (2+1)**

Development of key communication skills required by a Telecom / Electronic engineer, Techniques for presentation, interviewing, report-writing, meetings, negotiations, drafting of contracts and tender/marketing document, Quantitative appraisal of documentation: FOG index

## **ELEC1102: ANALOGUE ELECTRONIC (2+2)**

A basic knowledge of analogue electronics, which includes exposure to the most common components and focuses on the varied applications of the operational amplifier. A theoretical understanding of the benefits of negative feedback. Practical experience in circuit construction and characterization.

### **Outline**

Analogue electronics [Analogue vs. digital, typical uses of analogue electronics - amplification, signal processing, oscillators, measurement instrumentation]. Components [Qualitative description and applications of: diode, transistor (FET and bipolar), photodetectors, operational amplifier, more esoteric devices]. The ideal op-amp [Black box approach, practical embodiment, features of ideal op-amp (differential amplifier with infinite gain, infinite input impedance, zero output impedance), controlling the gain (feedback and the inverting amplifier) sample circuits (buffer, voltage addition, non-inverting amplifier, current to voltage conversion (photodetection), integrator and differentiator, high and low pass filters, rectifier, logarithmic amplifier, DAC and ADC)]. The real op-amp [Gain bandwidth, input offset voltage, input bias current, CMRR, input and output impedances, bipolar JFET and CMOS op-amps, choosing the right amplifier for the job].

## **ASE1102: MATERIALS SCIENCE AND ENGINEERING (2+1)**

Materials science or materials engineering is an interdisciplinary field involving the properties of matter and its applications to various areas of science and engineering.

Materials and their structures (metals, semiconductors and insulators), selected elements from periodic table, carrier transport: electrons and concepts of holes; density of selected elements. Composition of materials. Phase diagram sources. Thermodynamic and kinetic data (Bond strength; Melting point; solubility; phase change thermodynamic; heat of formation, fusion and sublimation; vapour pressure and diffusion). Thermal properties (conductivity and expansion). Mechanical properties (tensile, compressive, yield, flexural and shear strength; materials hardness; fatigue strength). Electrical properties (conductivity and resistivity; Dissipation factor; dielectric strength; tangent loss). Optical properties (transmission range and dispersion; transparency and refractive index of polymers). Chemical properties (water absorption of polymers; galvanic series of metals; corrosion rate; flammability); Magnetic Materials: Magnetic moment, magnetisation, field intensity. Magnetic susceptibility. Diamagnetic, paramagnetic and ferromagnetic materials; Other elements of natural sciences.

## **CAN1102: NETWORKS (2+1)**

Physical/logical LAN topologies. Communication devices and technologies used in LAN. LAN extension: repeaters and bridges. Switched LAN. WAN. Communication devices and technologies used in LAN. TCP/IP and LAN/WAN interconnection. The Internet as the single global network of networks. LAN interconnection through WAN: Routing, VLAN, VPN, RAS and tunneling. Mobile networking. LAN/WAN standards

## **HCA1109: COMPUTER AND MICROPROCESSOR ARCHITECTURE AND PROGRAMMING (2+2)**

Introduction to computer architecture & organization: RISC /CISC, superscalar. Instruction Set Architecture: addressing modes and formats, data types, operands and operations. Computer Evolution & Performance: Moore's Law, CPI, benchmarking tools and standards. Buses, Interrupts, Memory: cache, internal & external, I/O and operating system support. Computer arithmetic: Floating point arithmetic, RPN, Boolean algebra. Logic Design: Logic Gates, K-Maps, MSI chips, Circuits and latches, Sequential Circuit design. Advanced CPU functions: pipelining, branch prediction, ILP, etc. Microprogramming (Assembly language program development environment and tools, Analysis and development of microprograms, Standard program constructs: sequence, selection and iteration, Organising microprograms: assembler macros)

## **OSS1108: NETWORK OPERATING SYSTEMS (2+2)**

Basic operating system features such as support for processors, protocols, automatic hardware detection and support multi-processing of applications. Security features such as authentication, authorization, logon restrictions and access control. Name and directory services. File, print, web services, back-up and replication services

### **MATH1146: NUMBERS, LOGICS AND GRAPHS THEORIES (2+2)**

Elementary number theory, Sets relations and functions, Methods of logic and proof, Recurrence relations and difference equations, Counting principles, Trees and other graphs. Solving mathematical / engineering problems using high-performance language for technical computing (e.g. MATLAB).

### **ELEC2103: DIGITAL ELECTRONICS (2+2)**

Topics include encoding information in various digital formats, manipulation of real data using arithmetic, logic and relational operations, basic and combinational logic components, design, analysis and implementation of combinational logic circuits, principles of sequential logic and developing an understanding of memory elements and simple sequential circuits.

**Numbers and Character Systems:** General system of numbers, Decimal system, binary system, base or radix, MSB & LSB. Conversion between number systems including octal and hexadecimal. Binary arithmetic. Signed numbers - signed-magnitude, signed-complement. 9's and 10's complement, 1's and 2's complement. Binary codes. Weighted codes, complementary codes, error-detecting codes, mechanical (Gray) codes. Floating-point numbers. Character codes - ASCII.

**Combinational Logic:** Binary Logic. Logic functions: AND, OR, NOT. Truth table. Boolean Algebra - Huntington, De Morgan, Shannon. Boolean postulates and theorems. Principle of duality. Logic gates - complete set. Canonical forms - sum of products, product of sums. Minimisation of Boolean functions - Karnaugh map. NAND and NOR implementations of logic functions. Multiple-input gates. Minimisation using map-entered variables. Binary arithmetic Half-adder and full-adder, half-subtractor and full-subtractor. Multiplexers. Decoders. Encoder and priority encoder.

**Sequential Logic:** Memory, feedback, synchronous/asynchronous. Latches - basic SR latch, gated SR Latch, D-type, Master-slave latch, JK Latch. Shift Registers. Counters.

### **MATH2147: ENGINEERING MATHEMATICS (2+2)**

Matrix Algebra (Matrix operations, Solution of linear system of algebraic equations, Eigenvalues and eigenvectors). Calculus (Logarithmic differentiation, Improper integrals). Fourier series and Fourier integrals (Periodic functions, Euler formulae for Fourier coefficients, Fourier cosine and sine transformations, Linearity property, transform of derivatives, convolution theorem, Gamma and Beta functions, Error functions). Boundary value problems and systems of ODEs. Multivariable calculus (Partial derivatives, Directional derivatives, Chain rule, Maxima and minima). Solving mathematical / engineering problems using high-performance language for technical computing (e.g. MATLAB).

### **TELC2103: WIRELESS COMMUNICATIONS (2+2 RUN ON 2 SEMESTERS)**

Overview of wireless systems, transmission basics, analogue and digital data transmission, bandwidth and channel capacity, transmission impairments, Transmission media, analogue and digital modulation-demodulation, encoding-decoding techniques, error correction and detection, asynchronous and synchronous transmission, multiplexing, spread-spectrum techniques, wireless technologies, satellite communications (GEO, LEO, MEO), VSAT, PCS technology

### **TELC2123: DIGITAL SIGNAL PROCESSING (2+2 RUN ON 2 SEMESTERS)**

Signals, systems and signal processing; discrete-time signals and systems and its implementation, Z-Transform and applications, Frequency analysis of signals and systems, Discrete and Fast Fourier Transform, Design of Digital Filters, Case study of an active filter design and comparison with a digital filter, Sampling and Reconstructions of signals, Images and the spatial frequency domain; convolution and transform techniques; image coding techniques.

### **ASE2101: HEALTH, SAFETY & RISK IN ENGINEERING (2+1)**

Safety and Health Movement, Then and Now: Ethics and Safety, Roles and Professional Certifications for Safety and Health Personnel; Safety Management in a TQM Setting: Promoting Safety, Safety and Health Training, The OSH Act (2005)- Standard, Regulation & Practice. Comparisons with other countries.

### **CAN2113: SWITCHING TECHNIQUES (2+2)**

Introduction to Switching and Networks, Ethernet: Distributed Packet Switching for Local Computer Networks, Queueing in Networks, Single Stage Switching Systems, Multistage Switching Systems with Dynamic Routing, Multicast Switch Architectures with Dynamic routing (ATM Switch), Multistage Switching Systems with Static Routing, Unbuffered Switching Networks.

### **TELC2104: ANTENNAS AND RADIO WAVE PROPAGATION (2+2)**

Antenna Fundamentals, Hertzian dipoles, Yagi antenna, Antenna Parameters, Safety Precaution, Antenna Arrays, 2-element array, broadside, end-fire, n-element array, multiplication of arrays, binomial arrays, array factor, Radio Wave Propagation, troposphere, Process of refraction, Earth Curvature, Modelling of the ionosphere, Ionosphere propagation, Reflection from the ionosphere, Surface wave propagation

### **ASE2103: ELECTROMAGNETIC THEORY (2+1)**

- Electrostatic field: Dielectric interface, Laplace and Poisson's equations, energy & force. Steady currents: continuity equations, Ohm's law, Joule heating, current flow in materials.
- Magnetostatic field: Ampere's circuital law, scalar & vector potentials, Laplace and Poisson equations.
- Electromagnetic induction: Maxwell's equations; Solutions of field equations in rectangular, cylindrical and spherical coordinate system; Radiation generation; Propagation of electromagnetic waves; various boundary value problems; Principle of electromagnetic radiation & interaction with matter; Scientific and engineering applications of electromagnetic radiation.

### **MATH2148: ADVANCED ENGINEERING MATHEMATICS (2+2)**

Complex analysis (Functions of complex variables, Differentiation and 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, Expectation and confidence limits of random variables). Curve fitting (Method of least squares, Correlation and regression). Sampling distributions. Estimation of variances (Hypotheses concerning one variance, Hypotheses concerning two variances). Solving mathematical / engineering problems using high-performance language for technical computing (e.g. MATLAB).

### **TELC3111: RF SYSTEMS AND DESIGN (2+2)**

RF and wireless Technology. RF systems overview (Satellite, Radar, mobile etc), Transmitter and receiver system architecture, Modulation and Detection, Inter-symbol Interference, Non-linearity and time-invariance, use of ABCD parameters, Insertion loss, typical filter, Filter design, System stability, Return loss, Other components design, Distortion, path loss analysis, System Noise Figure, Sensitivity and Dynamic Range, sub-system architecture.

### **TELC3106: MICROWAVE ENGINEERING (2+2 RUN ON 2 SEMESTERS)**

An introduction to the design and analysis of active and passive radio frequency and microwave circuits. Topics include radio frequency and microwave circuit analysis, measurement methods, transmission line structures, matching networks, oscillators, and mixers. Computer-aided analysis and design. This module runs in two semesters.

#### **Outline**

Components of RF and microwave design, Behavior of passive components, Scattering parameters and signal flow diagrams, Using Smith Chart for design, Microstripline circuits, Passive networks and RF filters, Active RF components, Matching networks to active components, Transistor amplifiers, Oscillators, Mixers.

### **HCA3110: EMBEDDED SYSTEMS AND DESIGN (2+2 RUN ON 2 SEMESTERS)**

Embedded systems are a combination of hardware and software and run critical areas like communication, transportation and energy systems. This module provides crucial knowledge required to understand, analyze and design embedded systems and real time programming.

#### **Outline:**

Introduction to Embedded Systems  
Processor and Memory organization  
Devices and Buses for Device networks  
Device Drivers and Interrupts Servicing Mechanism  
Programming concepts and embedded programming in C and C++, Microprogramming  
Program Modeling Concepts for Software-Development Process  
Software Engineering Practices in the Embedded Software Development Process  
Inter-Process Communication and Synchronization of processes, tasks and threads  
Real Time Operating Systems.

### **TELC3107: IP TELEPHONY (2+2)**

Voice over Internet Protocol. 3-way calling. Secure calls. Integration with other services available over the Internet. VoIP traffic through firewalls and address translators. Quality of service. Integration into global telephone number system. Single point of calling. Mobile phones & Hand held Devices. Security. Pre-Paid Phone Cards. Caller ID. VoIM.

### **TELC3108: MOBILE COMMUNICATION ENGINEERING (2+2)**

Mobile communication Engineering overview, mobile-radio communication design, cellular concepts, Capacity related issues, blocking probability, Markov models and Erlangs, Mobile-radio signal environment, Statistical communication theory, Propagation models, Propagation mechanisms and effects, Large scale channel models, fading models, Received-Signal Envelope characteristics. Received-Signal Phase characteristics, Introduction to 3G and concept of spreading codes

### **MATH3149: SCIENTIFIC COMPUTING (2+2)**

Numerical Analysis, Errors in numerical computations, Numerical solution of algebraic and transcendental equations, Polynomial interpolation, Finite difference and finite element methods, Numerical differentiation, Numerical integration, Numerical solution of differential equations. Solving mathematical / engineering problems using high-performance language for technical computing (e.g. MATLAB).

### **TELC3109: TELECOMMUNICATIONS STANDARDS, REGULATION AND LEGISLATION (2+1)**

Forms of telecommunication, Development of Mobile Communication systems, Analogue mobile telephony, GSM, Policy and Regulation in European Union (ITU and WTO), Structure and techniques in Radio Communications, Cellular Telephony, Mobile radio networks, Packet switched mobile data communication (MOBITEX standard), Satellite comm. (INMARSAT A,B, VSAT), Telephony for aviation, Datacasting networks, FM radio, TV channels, Digital radio (DAB) and Digital TV (DVB-T), DVB-H, ETSI, RCC conference.

### **TELC3110: ELECTROMAGNETIC COMPATIBILITY (2+1)**

Emission issues. Susceptibility or immunity issues. Coupling Mechanisms. Conductive Coupling. Inductive coupling, Capacitive coupling. Magnetic coupling. Radiative Coupling. Types of Interference (Continuous, Pulse or Transient, Conduction). EMC Design. Laws and regulators (FCC, ETSI, BSI).

### **SEM3107: PROJECT MANAGEMENT FOR ENGINEERS (2+1)**

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 and Termination

### **ASE3101: RESEARCH METHODOLOGY (2+1)**

Research view, documenting, literature review, research ethics, research support, research proposals, tools of research, creativity, synthesis and evaluation, research types, measurement, analysis, models and simulations, optimization, writing the piece of work, presentation.

### **PROJ4201: PROFESSIONAL WORK PLACEMENT (15 WEEKS)**

Students will be attached to a telecom 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 in Telecommunication and Electronic Engineering and 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 in telecommunication engineering. The list of areas will be provided to the students by the school. This module is compulsory and is assessed by both a UTM and company supervisors in a panel of discussion. A UTM Telecom Professional Work Placement Handbook will be provided to the students.

### **SECU4114: SECURITY IN TELECOMMUNICATIONS (2+1)**

Basics of cryptography: symmetric and public-key encryption, certificates, cryptographic hash functions, Security Services and Mechanisms (E.g. ITU-T X.800), Web security: SSL/TLS, Denial of service, Internet worms, viruses, attacks on routing infrastructure, Firewalls and Intrusion Detection Systems, Wireless security: WEP, WPA, Privacy-enhancing technologies: RFID, Digital Rights Management: CSS.

### **PROJ4112: TELECOM PROJECT (1 LEVEL)**

Project allows the student to work independently to put the knowledge of electronics engineering theory and telecommunication systems into practice.

The student will collect all necessary information and analyze it, build/fabricate a prototype or develop necessary software and/or hardware or work on a mathematical/empirical model. The student will test the hardware/software or the mathematical model/empirical developed vigorously by known testing methods. The student will prepare and submit a report on the project. Broadly the report shall have these parts: Introduction, literature review, data collection and analysis, experiments conducted, design, prototype development/software implemented/empirical model and conclusions. Acquaintance with survey and research methods and their usage in conducting a systematic investigation and style of report preparation shall form basis of evaluation. A detailed Telecom Project Handbook will be provided to students before starting the projects.

### **TELC4111: SATELLITE COMMUNICATION SYSTEMS (2+1)**

Satellite communications (most recent applications and developments), Background and basic concepts of satellite communications, The orbital aspects - geostationary orbit, Frequency assignments and propagation, The design of a digital satellite link (link budgets, modulation, error control coding, baseband signaling theory, and multiple access methods), The satellite subsystem, launching methods, and on-board processing, Antennas and earth station technology are presented, including the design of very small aperture terminals (VSATs), Non-geosynchronous orbits and their applications, Specific applications of satellites ( global positioning system (GPS), satellites for mobile communication, and satellite for internet).

### **TELC4113: BROADBAND TELECOMMUNICATIONS (2+1)**

Introduction to broadband communication services and quality requirements, broadband reference model, broadband traffic characterization, ATM, Switching and multiplexing techniques, ATM protocol architecture, ATM adaptation layer, ATM signaling, ATM networks, ATM switching architectures, ATM congestion control techniques, FDDI, DQDB, synchronous digital hierarchy, optical networking , WDM networking and routing, photonic switching , optical access, edge and core networks, all optical networks, broadband access technologies, Modems, XDSL, HFC, wireless, cable modems, emerging broadband communication and networking technologies, Virtual private networks and Data VPN, Advanced intelligence network , Local Number Portability, Computer Telephony Integration, Signaling system architecture, CTI technologies and applications, ISDN, Frame Relay, ATM, Internetworking, Cable TV systems, IEEE 802.16x (WiMAX).



### **TELC4112: OPTICAL FIBRE COMMUNICATION SYSTEMS (2+1)**

Historical perspective and basic concepts, Channel capacity, optical fibers (Fiber modes, loss, non-linear optical effects, Manufacturing), optical transmitters (light-emitting diodes, semiconductor lasers, design), optical receivers (design, noise, sensitivity, degradation), systems design and performance, coherent lightwave systems and modulations, Multichannel lightwave systems, optical amplifiers (gain spectrum, bandwidth)

### **SEM4107: QUALITY ASSURANCE AND MANAGEMENT PRINCIPLES (2+1)**

Purchasing Principles and Management; Stores Management and Control; Procurement Management: Identifying the Procurement Requirement, Scanning the Market, Requesting for Tenders, Evaluating tenders, awarding contracts and holding debriefing sessions, maintaining a positive and ethical trading relationship, contract management including preventive and curative approaches; Central Tender Board Act 1994 and the Concessions Act 1997; Dispute Resolutions; Negotiation, Arbitration and Litigations, ISO.

### **CAN2103: COMMUNICATION & NETWORKING-DESIGN AND MANAGEMENT (2+1)**

- Introduction: Elements of enterprise networks: justifications, goals and benefits. Interoperability issues.
- Network Planning: Requirements Analysis, Business Model, Technology Model, Request for Proposals (RFP), Cost Analysis and Budgeting.
- Network Design: Traditional vs. Building Block Design, Geographic Scope, designing and configuring clients, servers, circuits and devices, Network Design tools.
- Network Management: Configuration, Fault, Performance and Cost Management, End-user Support, Network Management Tools: Hardware and Software, Performance metrics: speedup, Amdahl's Law. Properties of Simple Network Management Protocol (SNMP).
- Network Security: Firewalling, DMZ, subnetting, Application and Protocol Gateways, Authentication. Denial of Service attacks. Network viruses, Malware, Adware and Spyware.

### **ELEC4104: VLSI DESIGN AND TECHNOLOGY (2+1)**

This module lays a strong foundation for understanding VLSI circuits and their performance. Design of different CMOS integrated devices is covered in great detail along with testing.

**Circuit Characterization and Performance Estimation:** Resistance and capacitance estimation, switching characteristics, CMOS gate transistor sizing, power dissipation, sizing routing conductors, charge sharing designing margining yield and reliability

**Arithmetic Circuit in CMOS VLSI:** Bit adder circuits, Ripple carry adders, Carry look ahead adders, high speed adders, multipliers

**Design of Memories and Programmable Logic:** The static RAM, SRAM, Dynamic RAM, ROM ARRAYS, Logic ARRAYS

**System Level Physical Design:** Large scale physical design, interconnected delay modeling, crosstalk, interconnected scaling, floor planning & routing, I/P & O/P circuit, power dissipation and consumption, low power design considerations

**VLSI clocking and system design:** Clocked Flipflop, CMOS clock styles, Pipelined systems, Clock generation and distribution, system design considerations

**CMOS Testing:** The need for testing, manufacturing test principles, design strategies for test, chip level test techniques, system level test techniques, Layout design for improved Testability.

**Hardware Description Language:** Basic concepts, structural gate level modeling, switch level modeling, design hierarchies, behavioral and RTL modeling. VHSIC Hardware Description Language (VHDL programming). Verilog HDL.

**TELC4114: RADIO/TELEVISION BROADCASTING TECHNOLOGY (2+1)**

Channels and frequencies, bandwidth, Antenna, Transmitter and Receivers, Links, Analogue radio, FM radio, Analogue TV (PAL, SECAM), Digital Radio (DAB), Setting for Advanced TV, Digital Convergence, HDTV (US, Japan, Europe), Digital TV (US, Japan, Europe), SFN and MFN, Satellite TV, global standards, Radio and TV in smart devices, Business of TV.

**TELC4115: TELECOMMUNICATION AND NETWORKING IN BUSINESS (2+1)**

Infrastructure and protocols, Development in telecommunication and networking technology, International Experiences (global competition and cooperation in standardisation of wireless communication), organizational challenge in deploying telecommunication and networking technologies.

**TELC4116: CLOUD SYSTEMS ENGINEERING (2+1)**

Cloud technologies, Framework & Platforms. Internet of services, SOA, Grid computing, System types, architectures and models, applications to large telecommunication systems, systems benefits, virtualization, security and assurance, cloud systems examples (EC2, Force.com, MS Azure, etc), security management, Governance, legislation, economic environment.