MSc/PG Diploma in Electronic and Telecommunication Engineering Curriculum

Code	Course Unit	Credits	Lectures (Hrs)	Lab/Assig. (Hrs)
	Semester 1			
EE9013	Statistical & Numerical Methods	3	40	15
EE9022	Research Methodology I	2	30	0
EE9034	Project Management	4	50	30
ET9013	Communication Technology	3	40	15
ET9023	Modern Wireless Networks	3	40	15
ET9043	VLSI design and Nanotechnology	2	25	15
	Optional			
ET9053	Advanced Digital System Design	3	40	15
ET9073	Artificial intelligence Techniques	3	40	15
		20	350	120

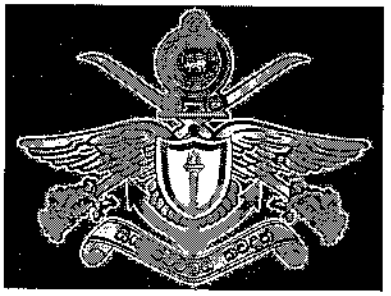
	Semester 2			
ET9113	Comm. Networks and Stochastic Simulation	3	40	15
ET9123	Microwave, Optical & Radar Engineering	3	40	15
EE9113	Operation Research	3	35	30
EE9122	Research Methodology II	2	25	15
EE9133	Power Electronic Designs	3	40	15
	Optional			
ET9133	Network Mgt. and Planning	3	40	15
ET9143	Information Security and Cryptography	3	40	15
BM9113	Medical Electronic and Biomedical Instrumentation	3	40	15
		20		
ET9999	Dissertation	20		
	Total	60		

Module Code	ET9177	**Module Title**	Deep Learning					
Credits	3	**Hours/Week**	**Lectures**	3	**Prerequisites**	-		
GPA/NGPA	GPA		**Lab/Assignments**	3/4				
Module Objectives		Understand full-stack deep learning by simulation and construct complex deep-learning solutions, and alsoto carry out research on deep learning						
Learning Outcomes		After the completion of this module, the student will be able to 1. Introduces the world of deep learning and discusses key building blocks of neural networks 2. Apply convolutional neural networks for image processing 3. Implement natural language processing using deep learning 4. Implement unsupervised methods in deep learning that use restricted Boltzmann machines (RBMs) and autoencoders. 5. Evaluate advanced neural networks: fully convolutional neural networks.						
Outline Syllabus		**Brief Revision on Essential Mathematical Concepts** Linear Algebra, Calculus ,Other Concepts:Dimensionality Reduction Methods, Regularization, Regularization Viewed as a Constraint Optimization Problem				LO		
		Introduction to Deep-Learning Concepts and Simulation Deep Learning and Its Evolution, Perceptrons and Perceptron Learning Algorithm, Simulation Platform-TensorFlow				LO		
		Convolutional Neural Network for Solving Real-World Problems Batch Normalization, Different Architectures in Convolutional Neural Networks, Transfer Learning				LO		
		Natural Language Processing Using Recurrent Neural Networks Vector Space Model (VSM), Vector Representation of Words, Word2Vec, Introduction to Recurrent Neural Networks				LO		
		Unsupervised Learning with Restricted Boltzmann Machines and Auto-encoders Boltzmann Distribution Bayesian Inference: Likelihood, Priors, and Posterior Probability Distribution, Markov Chain Monte Carlo Methods for Sampling, Restricted Boltzmann Machines, Auto-encoders, PCA and ZCA Whitening				LO		
		Advanced Neural Networks Image Classification and Localization Network, Object Detection Generative Adversarial Networks						
		Brief Introduction to Capsule Networks						

Degree of Master of Science and Postgraduate Diploma in Electronic and Telecommunication Engineering

Faculty of Engineering

Genaral Sir John Kotelawala Defence University



Eligibility and Performance Criteria

for the awards of the

Degree of Master of Science in Electronic & Telecommunication Engineering

and

Postgraduate Diploma in Electronic & Telecommunication Engineering

Effective from 01/01/2014

Eligibility and Performance Criteria

1 **Nature of Degrees/ Diplomas:** All courses are part time based and come under the type of taught programmes.

2 **Eligibility Requirements for admission to MSc/PG Diploma:**

Applicants satisfying the following requirements are eligible for admission:

2.1 Degree of the Bachelor of Science (Defence Studies) or Bachelor of Science in Engineering of General Sir John Kotelawala Defence University (KDU) in a relevant field of specialization, **OR**

2.2 Any other Engineering degree of at least four years duration, in a relevant field of specialization, from a recognized university, **OR**

2.3 Any other Engineering degree of at least three years duration, in a relevant field of specialization, from a recognized university **AND** a minimum of one year of appropriate experience after obtaining the degree, **OR**

2.4 Associate Membership or above (satisfying the educational requirements for Corporate Membership or similar graduate membership) of a recognized professional engineering institute in a relevant field **AND** a minimum of one year of appropriate experience after obtaining such membership.

3 **Participation in the Academic Programme:**

3.1 80% attendance is required in lectures.

3.2 Participation is compulsory for all assignments,

3.3 Prior approval must be obtained in writing from the University, with the necessary documentation, for leave of absence. Only such leave will be considered for any official purpose, such as considering a subsequent attempt as a first attempt.

3.4 The programme is planned to be completed in the normal duration, but a student may take time up to the maximum permitted duration.

3.5 Only the leave approved on medical grounds will be considered by the Senate in extending the maximum duration of study.

4 **Normal & Maximum Durations**

4.1 The normal duration for PG Diploma is one year comprising two Semesters

4.2 The normal duration for MSc is two years comprising ~~four~~ two Semesters

4.3 The maximum duration for PG Diploma is three years

4.4 The maximum duration for MSc is ~~four~~ five years

5 **Evaluation and Grading**

5.1 The performance of each student in each module will be evaluated by continuous assessment (CA) and end-of-semester examination (WE).

5.2 The continuous assessment of a student may be based on a specified combination of assignments including coursework, project work, design

project work, laboratory work, tutorials, field trips, field camps, quizzes, presentations, term papers and participation in the course activities.

5.3 Each Candidate should obtain at least 40% from each of CA and WE components.

5.4 Grade C+ or above is required to pass a module.

5.5 A student failing to reach 40% in one of CA or WE components receives an incomplete grade I, and is required to repeat only the failed component(s) as a repeat candidate to complete the module.

5.6 A student failing to reach 40% in both CA and WE components receives an F grade, and must repeat both components in order to upgrade the result.

5.7 A student obtaining 40% or more in both components but fails to obtain in a C+ grade has to repeat the WE component.

5.8 The grades *F* or *I* can be improved up to a *C+* grade. Students who wish to upgrade need to complete their examinations and obtain the upgraded grade before the relevant final board of examiners after the graduation requirements are met.

5.9 Except when an Academic Concession has been granted, the highest grade obtainable at a repeat attempt is the grade "C+".

5.10 The symbol "Ex" signifies an Academic Concession granted, in the event a student is unable to sit for the WE component due to illness or other compelling reason accepted by the BoS/Senate. In such instances the student must make an appeal, with supporting documents, to the BoS/Senate through the Dean Postgraduate Studies for an Academic concession.

5.11 Letter grades based on the Grade point system and corresponding description, as illustrated in the Table 5.1 will be used to express the performance at each module. Benchmark percentages are given for the guidance of the examiner and may be changed upwards or downwards by the moderator in consultation with the examiner.

Table 5.1 Grading System

Benchmark Percentage	Grade	Grade Point	Description
85 and above	A+	4.2	Excellent
75 to 84	A	4.0	
70 to 74	A-	3.7	Good
65 to 69	B+	3.3	
60 to 64	B	3.0	
55 to 59	B-	2.7	Pass
50 to 54	C+	2.3	
	I	0.0	Incomplete
	F	0.0	Fail
	Ex	---	Academic Concession

5.12 The Grade Point Average (GPA) is calculated based on the summation of Grade Points earned for all modules registered for credit (except those awarded with academic concession) weighted according to number of credits, as follows.

$$GPA = \frac{\sum n_i \times g_i}{\sum n_i}$$

where n_i is the number of credits for the i^{th} module and g_i is the grade points earned for that module.

5.13 The GPA is rounded to the nearest second decimal place and reported on the transcript.

6 Academic Concession

6.1 A student who has missed a WE or any other course requirement because of illness or other compelling reason may appeal with supporting documents to the Dean Postgraduate Studies. In case of an examination, the student should submit an application with supporting documents within two weeks from the date of the examination. In instances where a student misses any other course activity such as CA, the student should submit the application with supporting documents before the last date of academic activities of the relevant semester.

6.2 An Academic Concession may be granted for medical reasons and other exceptional circumstances subject to the approval by the Senate of the University.

7 Academic requirement for the award of PG Diploma and progression to the MSc

7.1 A candidate completes the academic requirement for the award of PG Diploma only if he/she has earned 40 Credits including all the compulsory Credits specified in the respective curriculum within the maximum duration (see clause 4).

7.2 Those who satisfy the requirement in 7.1 with an overall GPA of not less than 2.5 can decide to proceed to 2nd year (MSc).

8 Award of PG Diploma

8.1 Following are eligible for the award of respective PG Diploma

a) Those who satisfy the academic requirement for the award of respective PG Diploma and do not proceed to 2nd year (MSc).

b) Those who proceed to MSc but do not complete requirements for the award of respective MSc within the stipulated maximum period (see clause 4).

8.2 Classes will not be awarded.

9 Award of MSc

9.1 A candidate is eligible for the award of MSc only if he/she has earned 60 Credits including all the compulsory Credits specified in the respective curriculum within the maximum duration (see clause 4).

9.2 Classes will not be awarded.

Genaral Sir John Kotelawala Defence University

By-Law

for the awards of the

Degree of Master of Science in Electronic & Telecommunication Engineering

and

Postgraduate Diploma in Electronic & Telecommunication Engineering

Effective from 01/01/2014

By-Law

1 **Nature of Degrees/Diplomas:** All four courses are part time based and come under the type of taught programmes.

2 **Eligibility Requirements for the Admission to MSc/PG Diploma:**

The minimum eligibility requirements for admission to PG Diploma and the minimum requirements to proceed to the respective MSc are as set out in the approved "Eligibility and Performance Criteria" referred to as EPC hereafter.

3 **Registration**

3.1 All candidates, including internal candidates, shall register annually by paying prescribed fees until they have completed the requirements for the award of the respective MSc/PG Diploma.

3.2 The applicant shall register initially for the respective MSc/PG Diploma within the specified period after the BoS/senate approval.

3.3 An applicant may request a deferment of the registration to the next available intake for the approval of the BoS/Senate on the recommendation of the Faculty of Graduate Studies (FGS).

3.4 The effective date of registration shall be the date of commencement of the programme, as announced by the FGS.

3.5 If the academic requirements for the award of PG Diploma are not fulfilled within the current registration period the student can opt to register for an extended year as far as the total period is within the maximum period for the PG Diploma stipulated in the EPC.

3.6 Only the student registered for MSc/PG Diploma who fulfills the academic requirements for the award of the PG Diploma and satisfies the requirement stipulated in EPC can register for the MSc.

3.7 If a student registered for MSc does not fulfill the academic requirements for the award of the MSc within the current year of registration he or she may apply for an extension of the registration by another year within the maximum period stipulated for MSc in the EPC.

4 **De-registration**

De -registration of a student may be permitted by the BoM/Senate on a written request by the student.

5 **Termination**

5.1 Registration of a student will terminate automatically if the student fails to renew his/her registration or the maximum duration of study stipulated in EPC has expired.

5.2 Registration of a student can be terminated by the senate on the recommendation of the FGS for reasons of poor performance, or any other valid reason acceptable to the Senate. In such instance, sufficient evidence must be presented to the Senate to justify the termination.

6 **Program of study**

6.1 The PG Diploma shall consist of the following:

a) A regular taught course of lectures at the University, normally 40 credits, as envisaged in the curriculum approved by the Senate;
b) Assignments, such as Course work, Project work, Design project work, Laboratory work, Tutorials, Field trips and Field camps, for which the credits are allocated in section (a) and as envisaged in the curriculum approved by the Senate.

6.2 MSc Degree shall consists of the following

a) 6.1.(a) and 6.1(b) above
b) Research in a specified area under the guidance of a Supervisor(s), normally 20 credits, the results of which shall be presented in the form of a Dissertation or Design Project Report as envisaged in the curriculum approved by the Senate.

The Normal and Maximum durations for MSc and PG Diploma are as stipulated in the EPC.

7 Scheme of evaluation

The performance of a candidate shall be assessed in individual modules, based on any one or combination of the following components:

a) Written examination(s);
b) Assignments;
c) Examination of the Dissertation or Design Project Report including a Viva-voce examination where applicable.

If the performance of a student is below the pass mark specified in the EPC for (a), (b) or (c) above of a module, the student may be re-examined in that component after a period of time specified by the FGS.

8 Schedule of fees

The schedule of fees shall be as laid down by the Board of Management (BoM) on the recommendation of the BoM/Senate and set out as a separate document. The applicable schedule of fees for a particular candidate shall be as determined at the time of initial registration of the candidate for the programme.

9 Award of PG Diploma

9.1 A student registered for MSc/PG diploma fulfilling the academic requirements for the award of PG Diploma is awarded the respective PG Diploma on application.

9.2 A student registered for MSc but not completed the requirement for the award of the MSc within the permitted duration or adjudged by FGS as not meeting the standards required to pursue a MSc or opt to discontinue the MSc is awarded the PG Diploma on application.

10 Award of MSc

A student registered for MSc fulfilling the academic requirements for the award of MSc is awarded the respective MSc on application.

11 Effective date of the award

The effective date of the award of the Degree/Diploma shall be the first day of the month following the satisfactory completion, by the candidate, of the requirements for the award as specified in the EPC.

Schedule of Fees

Application fee	Rs. 1000.00
Registration fee	Rs. 2000.00
Examination fee – per module	Rs. 1000.00

Registration fee

Initial registration for MSC/PG Diploma 150,000.00	Rs.
First Registration for MSc after satisfying requirements to proceed to MSc	Rs. 75,000.00
Extended year for MSc/PG Diploma or MSc	Rs. 25,000.00
Library deposit (refundable)	Rs. 5,000.00

Fees paid are not refundable.

CURRICULUM & SYLLABI

MSc/PG Diploma in Electronic and Telecommunication Engineering

Department of Electrical, Electronic and Telecommunication Engineering

Faculty of Engineering

30.4.5 APPROVAL FOR REVISED COURSE CURRICULUM - MBA IN E-GOVERNANCE- (Annex M)

Ms. Dushyanthi Vidanagama explained the revised curriculum to the Board which was approved at the BoS on Engineering and Spatial Sciences held on 21st November 2018. The Chairman inquired that was mainly revised from the previous course curriculum. There, she explained that it is the new research component delivery plan.
Dean- Research, suggested that the term "plagiarism" should be replaced with "Similarity Index"

Decision
Subjected to the above correction, the revised Course Curriculum was approved at the Faculty Board and decided to forward for the approval of Senate. AR- FGS

30.4.6 APPROVAL FOR THE INTRODUCTION OF DEEP LEARNING FOR MSc IN ELECTRONICS AND TELECOMMUNICATION ENGINEERING (Annex N)

Eng. SU Dampage explained briefly about its overview and purpose.

Decision
Introduction of Deep Learning Module as an elective subject was approved and to be forwarded for the approval of Senate. AR- FGS

Faculty Board held on 20 Dec 18

SOB

30.4.7. APPROVAL FOR THE REDUCTION IN NUMBER OF CREDITS FOR DISSERTATION IN LLM PROGRAMME

Dean FOL, Mr. WM Amaradasa stated that this reduction was introduced in order to be in par with SLQF standards.

Decision
The reduction of the number of credits was approved by the Faculty Board and to be forwarded for the approval of the Senate

30.4.8 APPROVAL OF PREVIOUS MINUTES

30.4.8.1 BoS on Management and Social Studies Meeting No 13(Annex O)
30.4.8.2 BoS on Medical and Biological Sciences Meeting No.07 (Annex P)
30.4.8.3. BoS on Engineering, Computing & Spatial Sciences Meeting No 07 (Annex Q)

Decision
Board approved the minutes.

Introduction of Subject area: Deep learning in to

Msc/PG Diploma in Electronics and Telecommunication Engineering programme.

Code	Course Unit	Credits
	Semester 1	
EE 9013	Statistical & Numerical Methods	3
EE9022	Research Methodology I	2
EE 9034	Project Management	4
ET 9013	Communication Technology	3
ET 9023	Modern Wireless Networks	3
ET 9043	VLSI Design and Nanotechnology	2
	Optional	
ET 9053	Advanced Digital System Design	3X1
ET 9072	Artificial intelligence Techniques	
		20

Semester 2

ET 9113	Comm , Networks and Stochastic Simulation	3
ET 9123	Microwave , Optical & Radar Engineering	3
ET 9113	Operational Research	3
ET 9122	Research Methodology II	2
ET 9133	Power Electronic Designs	3
	Optional	
ET 9133	Network Mgt , and Planning	3X2
ET 9143	Information Security and Cryptography	
BM 9113	Medical Electronic and Biomedical Instrumentation	
ET 9144	**Deep Learning**	
		20
ET 9999	Dissertation	**20**
		60

Note: No change in number of credits either in total number in a semester or within the whole course.

Module Code	ET9144 ~~ET9177~~	**Module Title**	Deep Learning				
Credits	3	**Hours/Week**	**Lectures**	3	**Prerequisites**		
GPA/NGPA	GPA		**Lab/Assignments**	3/4			
Module Objectives	Understand full-stack deep learning by simulation and construct complex deep-learning solutions, and alsoto carry out research on deep learning						
Learning Outcomes	After the completion of this module, the student will be able to 1. Introduces the world of deep learning and discusses key building blocks of neural networks 2. Apply convolutional neural networks for image processing 3. Implement natural language processing using deep learning 4. Implement unsupervised methods in deep learning that use restricted Boltzmann machines (RBMs) and autoencoders. 5. Evaluate advanced neural networks: fully convolutional neural networks.						
Outline Syllabus	**Brief Revision on Essential Mathematical Concepts** Linear Algebra, Calculus ,Other Concepts:Dimensionality Reduction Methods, Regularization, Regularization Viewed as a Constraint Optimization Problem					LO	
	Introduction to Deep-Learning Concepts and Simulation Deep Learning and its Evolution, Perceptrons and Perceptron Learning Algorithm, Simulation Platform-TensorFlow					LO	
	Convolutional Neural Network for Solving Real-World Problems Batch Normalization, Different Architectures in Convolutional Neural Networks, Transfer Learning					LO	
	Natural Language Processing Using Recurrent Neural Networks Vector Space Model (VSM), Vector Representation of Words, Word2Vec, Introduction to Recurrent Neural Networks					LO	
	Unsupervised Learning with Restricted Boltzmann Machines and Auto-encoders Boltzmann Distribution Bayesian Inference: Likelihood, Priors, and Posterior Probability Distribution, Markov Chain Monte Carlo Methods for Sampling, Restricted Boltzmann Machines, Auto-encoders, PCA and ZCA Whitening						
	Advanced Neural Networks Image Classification and Localization Network, Object Detection Generative Adversarial Networks						

	Brief Introduction to Capsule Networks
Method of Assessment	Continuous assessment (40%) – Assignments (10%) and Mini Project (40%) Final written exam (50%)
References	Ian Goodfellow, YooshuaBengioand AaronCourville, "Deep Learning"

Semester-1: Statistical & Numerical Methods (Compulsory Module, ET and EE)

<table>
<tr><td>Module Code</td><td>EE9013</td><td>Module Title</td><td colspan="4">STATISTICAL & NUMERICAL METHODS</td></tr>
<tr><td>Credits</td><td>3</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>40</td><td rowspan="2">Co-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>15</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">To instill learners with concepts and tools of statistics and numerical method to solve
advanced engineering problems</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">After the completion of this module, the student should be able to
1. Estimation ,sampling distributions and confidence intervals
2. Partial regression, ANOVA and use of available software
3. Stochastic processes, Markov chains and time series analysis
4. Random processes, auto and cross correlation, spectral densities and uses Numerical Techniques
5. Direct and fast iterative methods to solve large linear systems
6. Vibration analysis by determination of eigen values
7. Solve initial and boundary value problems using finite difference methods
8. Calculus of variations, introductory finite element method
9. Use of available software in above applications</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Review point & line estimation ,normal t-, chi square distributions and confidence intervals
2. Partial regression coefficients, use of ANOVA tables and use of available software
3. Stochastic processes, Markov chains and time series analysis ad uses
4. Random processes, auto and cross correlation, spectral densities and uses Numerical Techniques
5. Factorisation and fast iterative methods to solve large linear systems
6. Iterative methods to determination of eigen values of linear & non linear problems
7. Solve initial and boundary value problems using finite difference methods
8. Calculus of variations, introductory finite element method
9. Use of available software in above applications</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Semester - end Examination: 70
Assignments: 25 and Class Quizzes: 5</td></tr>
<tr><td colspan="2">References</td><td colspan="5">1. Statistical Methods by S.P. Gupta, Sultan Chand and Sons publishers
2. Fundamental Statistics by S. C. Gupta
3. Essential Statistics by A.B. Rao
4. Statistics by E . Narayanan Nadar
5. Probability and Statistics for Engineers and Scientists by Ronald E. Walpole
6. Mathematical Statistics with Applications by I. Miller and M. Miller
7. Advanced Engineering Mathematics (Second Edition) by Michel D. Greenberg
8. Mathematical Techniques for Engineering and Scientists by Larry C. Andrews, Ronald L. Phillips.
9. Mathematical Methods by S.R.K. Lyengar, R.K.Jain
10. Numerical Methods for Mathematics, Science , and Engineering by John.Mathews</td></tr>
</table>

Semester-1: Research Methodology I (Compulsory Module, ET and EE)

<table>
<tr><td>Module Code</td><td>EE9022</td><td>Module Title</td><td colspan="4">RESEARCH METHODOLOGY I</td></tr>
<tr><td>Credits</td><td>2</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>30</td><td rowspan="2">Co-requisites</td><td rowspan="2">-</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>0</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">-</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">After the completion of this module, the student should be able to
1. List Hallmark features of Science
2. Identify key steps in Scientific Method of Research
3. Describe relationships among observation, problem definition and hypothesis
4. Critically analyze applicability of various approaches to experimental design
5. Apply data collection and data analysis techniques for own area of research</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Introduction to Research
2. Overview of different types of Research
3. Hall mark of Scientific Research
4. Key steps in Scientific Method of Research
5. Essentials of Experimental Design
6. Methods of Data Collection
7. Data Analysis and Conclusions
8. Structuring of Scientific documentations</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Report on Analysis of a real world scenario related to a selected area of study to demonstrate the developments of steps in scientific method of research</td></tr>
<tr><td colspan="2">References</td><td colspan="5">1. Uma Sekaran (2009), Research Methods for Business, A Skill Building Approach, Wiley India
2. Asoka S Karunananda (2008), How to do Research</td></tr>
</table>

Semester-1: Project Management (Compulsory Module, ET and EE)

<table>
<tr><td>Module Code</td><td>EE9034</td><td>Module Title</td><td colspan="4">PROJECT MANAGEMENT</td></tr>
<tr><td>Credits</td><td>4</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>50</td><td rowspan="2">Co-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>30</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">The main objective is to provide the knowledge of managing the small and large scale projects by considering all key aspects areas.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">By the end of this course, student should be able to
1. Distinguish project management from day to day management of business
2. Demonstrate sufficient knowledge in various disciplines of project management
3. Acquire necessary skills and ability to use modern day tools for project management</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Project management concepts
2. Characteristics of a project
3. Project cost estimation
4. Feasibility report
5. Project financing
6. Project appraisal
7. Project control
8. Risk mitigation and management
9. Project scheduling
10. Conflict resolution and negotiations
11. Software tools for project management</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Semester-end Examination: 70
Assignments: (continuous): 30</td></tr>
<tr><td colspan="2">References</td><td colspan="5">-</td></tr>
</table>

Semester-1: Communication Technology (Compulsory Module)

<table>
<tr><td>Module Code</td><td>ET9013</td><td>Module Title</td><td colspan="4">Communication Technology</td></tr>
<tr><td>Credits</td><td>3</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>40</td><td rowspan="2">Co-requisites</td><td rowspan="2">-</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>20</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">The main objective is to provide the knowledge of designing communication systems for given requirements and the knowledge of physical layer designing and the critical parameters.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">After the completion of this module, the student should be able to
1. Knowledge of Information, traffic handling, analog and digital signals
2. Device level and channel level parameters that have to be considered during the designing phase.
3. Solid state semiconductor devices used in different stages of communication systems and instrumentation.
4. Knowledge of commercially available physical layer communication systems</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">The knowledge of physical layer designing and the critical parameters to be considered.
1. 1.Signals, Speech, Image Encoding and decoding, Analog and digital signals and spectra
2. Distortion of signals during propagation, LTI systems and equalization and filtering, noise in communication systems.
3. Information Theory and Tele-traffic Engineering, BSC, Mutual information and source coding and channel coding.
4. Solid state devices for communication systems, Antennae, Power amps, LNA Impedance Matching
5. Introduction to communication systems (analog and digital) Continuous wave modulation and demodulation, Digital modulation and demodulation and spectra and comparison. Introduction to designing of communication systems and Introduction to communication system Instrumentation</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Presentations on communication technology topics and Assignments:
Student can select one out of the following three assignments
1. Designing a low noise down convertor at 3.4-20 GHz range (Matlab simulation)
2. FPGA based speech recognition system
3. comparison of PAN protocols</td></tr>
<tr><td colspan="2">References</td><td colspan="5">1. Behzad Razavi (Oct 2, 2011). RF Microelectronics (2nd Edition) :Prentice Hall Communications Engineering and Emerging Technologies Series):
2. Thomas M. Cover, Joy A. Thomas (2006). Elements of Information Theory 2nd Edition: Wiley Series in Telecommunications and Signal Processing.
3. Gerard Maral, Michel Bousquet and Zhili Sun (Feb 1, 2010). Satellite Communications Systems: Systems, Techniques and Technology</td></tr>
</table>

Semester-1: Modern Wireless Networks (Compulsory Module)

<table>
<tr><td>Module Code</td><td>ET9023</td><td>Module Title</td><td colspan="4">MODERN WIRELESS NETWORKS</td></tr>
<tr><td>Credits</td><td>3</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>40</td><td rowspan="2">Co-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>5</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">The main objective is to provide the knowledge of design and implementation of wireless system for the given requirements</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">After the completion of this module, the student should be able to achieve following outcomes
1. Understand the mobile communication history, current and future trends
2. IEEE 802.11 based WLAN schemes: IEEE 802.11a/b/g/n/e
3. Knowledge about the key mobile technologies: UMTS, HSPA, LTE and LTE-A
4. Understand the effects of mobility on broadband wireless communications
5. Knowledge about radio resource management and MAC scheduling (HSPA,LTE)
6. Ability to research future mobile communication technologies</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">The Lecture consist of the following content
1. History of mobile communications and standardization
2. Basics of wireless and mobile communications:
a) Frequencies for Communication (Spectrum), Radio Propagation, Multipath Propagation, Effects of Mobility and Interferences
b) System and radio access network architecture (UMTS Network Topology, UTRAN, UMTS Core Network (CN), HSDPA, LTE and LTE Advanced)
3. 802 Standard and Wireless LANs
a) Physical Layer : IEEE 802.11 a/b/g
b) MAC Layer, CSMA/CA, Point Coordination Function, Distributed Coordination Function, IEEE 802.11 Extensions: 802.11e – QoS, 802.11n – Higher Speed
4. UMTS,HSPA, LTE and LTE-A
a) Mobility control, Physical Layer of UMTS (R99/HSPA)
b) LTE and LTE-Advanced Radio Features: LTE Duplexing Modes and OFDM Basics, Transport and Physical Channels, DL Operation
c) Fundamental radio resource management, MAC scheduling and Mobility Control
d) Coverage, Power Control, Load Control, Call Admission Control, Congestion Control, Rate Adaptation, Interference Coordination,
e) Best Effort scheduler and Proportional Fairness, Scheduler Inputs/Outputs, QoS Scheduling
5. Current and future trends in 3GPP –HSPA+ and LTE-advanced</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Continuous Assessment through Assignments: 30%
Three hour Written Test: 70%</td></tr>
<tr><td colspan="2">References</td><td colspan="5">1. H. Holma and A. Toskala, "LTE for UMTS", John Wiley & Sons, 2009
2. J. Laiho, A. Wacker, T. Novosad, "Radio Network Planning and Optimization for UMTS", JohnWiley& Sons, 2002
3. Jim Geier, Designing and Deploying 802.11n Wireless Networks, 2010
4. EldadPerahia and Robert Stacey, 'Next Generation Wireless LANs: Throughput, Robustness, and Reliability Throughput, Robustness, and Reliability in 802.11n, 802.11ac</td></tr>
</table>

Semester-1: VLSI DESIGN AND NANOTECHNOLOGY (Elective Module)

<table>
<tr><td>Module Code</td><td>ET9043</td><td>Module Title</td><td colspan="4">VLSI DESIGN AND NANOTECHNOLOGY</td></tr>
<tr><td>Credits</td><td>3 (2)</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>40</td><td rowspan="2">Co-requisites</td><td rowspan="2">-</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>15</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">The main objective is to provide the student knowledge of VLSI design, software tools available and Nanoelectronics and nanofabrication processes</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">After the completion of this module, the student should be able to
1. End of the course student will be able to gain the knowledge of CMOS design and VLSI design
2. Will gain the knowledge of introduction to Nanotechnology and nanoelectronic devices.
3. Will able to gain the knowledge of fabrication methods and applications of nanoelectronics.</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. VLSI Design
a) CMOS LOGIC circuits, IC layout and Fabrication, CMOS circuit characterization
b) Sequential logic circuits, Alternative logic structures, sub systems design Testing
c) Physical design and automation, Parallel structures Array processors, Fault tolerant VLSI Architecture
2. Nano electronics
a) Quantum Devices Nanoelectronic devices, Molecular Nanoelectronics Spintronics,
b) Nanoelectronic architecture and computations, Fabrication processes</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Presentations on nanoelectronics topics and projects
Continuous Assessment through Assignments: 30%
Three hour written Test: 70%</td></tr>
<tr><td colspan="2">References</td><td colspan="5">1. Weste and David Harris (Mar 11, 2010). CMOS VLSI Design: A Circuits and Systems Perspective (4th Edition) Neil
2. Sergey Edward Lyshevski (May 30, 2007). Nano and Molecular Electronics Handbook (Nano and Microengineering Series)</td></tr>
</table>

Semester-1: Advanced Digital Systems & Design (Elective Module)

<table>
<tr><td>Module Code</td><td>ET9053</td><td>Module Title</td><td colspan="4">ADVANCED DIGITAL SYSTEMS & DESIGN</td></tr>
<tr><td>Credits</td><td>3</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>40</td><td rowspan="2">Co-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>15</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">The main objective is to provide the student knowledge of advanced digital design based on FPGAs</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">1. Demonstrates the required skills in VHDL that facilitate rapid prototyping of digital systems.
2. Design sequential systems using RTL based approach
3. Describe different approaches available for processor design Identify the key stages in designing a processor. Analyse the requirements of a system to decide whether a custom made processor is required Design a custom made processor
4. Describe the requirements to use asynchronous sequential based approaches</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Synchronous and Asynchronous Sequential system design Introduction to asynchronous sequential systems race conditions stability issues state reduction techniques.
2. RTL based System Design Introduction to RTL based design, data paths and controllers.
3. CISC & RISC Architecture 8086 and ARMs Features of RISC architecture, pipelining, register windows, register renaming.
4. Processor design Instruction set architecture, hardwired and micro programming approaches to processor design.
5. Busses and peripheral design ISA, PCI, GPIB and VXI
6. Memory Design and CPLDs RAM, ROM, SRAM, DRAM, memory cells and memory organizations, cache, memory design , memory interfacing, PAL,PLA, FPGAS
7. Hardware Descriptive Language Introduction to reconfigurable computing, circuit specification using hardware descriptive languages use of VHDL Languages. Implementing CLCs and SLCs.</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Semester-end Examination: 80
Assignments: 20</td></tr>
<tr><td colspan="2">References</td><td colspan="5"></td></tr>
</table>

Semester-1: Artificial Intelligent Techniques (Elective Module)

<table>
<tr><td>Module Code</td><td>ET9073</td><td>Module Title</td><td colspan="4">ARTIFICIAL INTELLIGENT TECHNIQUES</td></tr>
<tr><td>Credits</td><td>3</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>40</td><td rowspan="2">Co-requisites</td><td rowspan="2">-</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>15</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">The main objective is to provide knowledge to design and development of a systems using the Artificial Intelligent Techniques</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">After the completion of this module, the student should be able to
5. Describe four schools of thoughts in Artificial Intelligence
6. Apply Turing Test for determining machine intelligence
7. Distinguish between Machine Learning and Cognitive Systems
8. Identify major techniques in Artificial Intelligence
9. Determine suitability of AI techniques for selected real world problems
10. Identify major trends in future of AI</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Introduction to Artificial Intelligence (AI)
2. Major areas of AI
3. Applications of AI techniques for real world problems
4. Essentials of Machine Learning techniques
5. Essential of Cognitive Systems
6. Future trends in AI</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Model a real world problem using a suitable AI technique (Machine Learning or Cognitive Systems
Semester-end Examination: 70
Assignments: 30</td></tr>
<tr><td colspan="2">References</td><td colspan="5">Artificial Intelligence: A Modern Approach (2nd Edition), Stuart J. Russell and Peter Norvig</td></tr>
</table>

Semester-2: Communication Networks and Stochastic Simulation (Compulsory Module)

<table>
<tr><td>Module Code</td><td>ET9113</td><td>Module Title</td><td colspan="4">COMMUNICATION NETWORKS AND STOCHASTIC SIMULATION</td></tr>
<tr><td>Credits</td><td>3</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>40</td><td rowspan="2">Co-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>15</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">The main objective is to provide knowledge to design and development of complex systems models and performance analysis</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">After the completion of this module, the student should be able to achieve following outcomes
1. Understand the basic communication protocols and their functionalities
2. Ability to design and develop protocols of communication networks
3. Understand new network architectures and their functionalities
4. Understand the stochastic simulation basics and principles
5. Knowhow about mathematically modeling of a complex system and analysis
6. Understand the impact of random numbers on stochastic simulation
7. Knowledge about evaluation and performance analysis of discrete event simulations</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">The Lecture consist of the following content
1. Basic introduction to distributed systems, ISO/OSI reference model for open systems. Technical infrastructure for information and communication systems, Circuit switching and packet switching networks, connection oriented and connectionless networks, service models.
2. Physical and Data Link Layers
Multiple access protocols, MAC: Medium Access Control, Error Probabilities, FEC and ARQ Methods, IEEE 802 Standards and details about PHY and MAC layers
3. Network (IP) and Transport Layers (TCP/UDP)
Internet Protocol and their key protocol functionalities, TCP and UDP, protocol functions, features and behaviour
4. Statistical evaluation and performance measures
Evaluation goals, Terminating simulations and Sampling theory Effects of random numbers, generation and transformation techniques
5. Random number generation: discrete and continuous
RNG Techniques and issues, Base generator and pseudo random number generators
6. Stochastic processes (SP) and Markovian processes (MP)
Markovian processes and Non-Markovian processes, M/M/1 models and MG1 models</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Continuous Assessment through Assignments: 40%
Three hour Written Test: 60%</td></tr>
<tr><td colspan="2">References</td><td colspan="5">1. NevioBenvenuto and Michele Zorzi, Principles of Communications Networks and Systems, 2011
2. Thomas Robertazzi, Basics of Computer Networking (SpringerBriefs in Electrical and ComputerEngineering), 2011
3. Chee-Hock Ng, Soong Boon-Hee, Queueing Modelling Fundamentals: With Applications in Communication Networks, 2008
4. Jack L. Burbank, William Kasch and Jon Ward, An Introduction to Network Modeling and Simulation for the Practicing Engineer.</td></tr>
</table>

Semester-2: Microwave, Optical & Radar Engineering (Compulsory Module)

<table>
<tr><td>Module Code</td><td>ET9123</td><td>Module Title</td><td colspan="4">MICROWAVE, OPTICAL & RADAR ENGINEERING</td></tr>
<tr><td>Credits</td><td>3</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>40</td><td rowspan="2">Co-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>15</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">The main objective is to provide knowledge to design and development of microwave, optical and radar systems</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">By the end of this course, students should be able to:
1. Design techniques of patch antenna array
2. Design a narrow band and a broad band microwave transistor amplifier
3. Describe the optical network of the land based communication system
4. Identify optical access technologies used in Sri Lanka
5. Describe Surveillance & Tracking radar systems
6. Identify the uses of Synthetic Aperture Radar</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Design techniques of patch antennas [8 hrs]
Coaxial lines, metal waveguides and microstrip transmission lines
Microwave antennas and design of patch antenna arrays
2. Design a narrow band and a broad band microwave transistor amplifier [6 h]
Semiconductor devices for microwave amplification
Microwave Tubes for signal amplification
Microwave transistor amplifier design
3. Describe the optical network for high capacity information exchange [10 hrs]
Optical fibres, attenuation and dispersion
Optical sources and detectors for optical communication systems
Optical networks: Modulators, Amplifiers, Multiplexers and other components
Power budget
4. Identify optical access technologies
Broadband access technologies
Passive and Active optical access networks
FTTX technologies for ultimate broadband access
5. Describe Surveillance & Tracking radar systems
Microwave and HF Radar systems
Detection of radar signals in noise
Radar Antennas
6. Synthetic Aperture Radar (SAR)
Principle and uses of SAR</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Continuous Assessment through Assignments: 40%
Three hour Written Test: 60%</td></tr>
<tr><td colspan="2">References</td><td colspan="5">Microwave transistor Amplifiers – Analysis and Design; Guillermo Gonzales, Prentice-Hall, Inc., Second Edition, ISBN: 0 13 254335 4</td></tr>
</table>

Semester-2: Operation Research (Compulsory Module ET & EE)

Module Code	EE9113	**Module Title**	OPERATION RESEARCH				
Credits	3	**Hours/Week**	**Lectures**	40	**Co-requisites**		
GPA/NGPA	GPA		**Lab/Assignment**	15			
Module Objectives		To instill learners with concepts and tools of optimization & operation research to solve advanced engineering problems					
Learning Outcomes		1. Classical optimization methods, penalty function and search techniques 2. Dynamic programming 3. Queuing theory 4. Game theory 5. Simulation and Monte Carlo methods 6. Genetic algorithm 7. Use of available software in above applications					
Outline Syllabus		1. Optimization using Lagrange multiplier, Kuhn-Tucker condition, penalty function and search techniques 2. Dynamic programming , allocation, knap sac problem 3. Queuing theory & application to networks 4. Game theory, introduction to Nash extension 5. Simulation and Monte Carlo methods, use of random numbers 6. Genetic algorithm 7. Use of available software in above applications					
Method of Assessment		Semester-end Examination: 70 Assignments: 25 and Class Quizzes: 5					
References		Taha, Hamdy A (2002), Operations Research, 7th ed., Pearson Education, (CD-ROM Tora included)					

Semester-2: Research Methodology II (Compulsory Module ET & EE)

<table>
<tr><td>Module Code</td><td>EE9122</td><td>Module Title</td><td colspan="4">RESEARCH METHODOLOGY II</td></tr>
<tr><td>Credits</td><td>2</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>30</td><td rowspan="2">Co-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">To provide knowledge to develop the presentation skills, scientific paper and report writting.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">After the completion of this module, the student should be able to achieve following outcomes
1. How to perform feasibility study of scientific research
2. Improve the scientific writing and presentation skills (research problems, methodology, data gathering and analysis, and conclusion)</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">Within the focus of research methodology II, students should select proper scientific publication of their interest that is published in reputed international journal (or conference).
1. Approved journal/paper selection: the selected scientific publication must be approved by the respective supervisor
2. Student should carefully go through the research paper and acquire important research findings of it
3. Read and understand the research concepts, presentation formats and applied modeling tools and data analysis of the selected paper
4. Report writing: Summarize the content of the research publication along with key findings.
5. Presentation skills: student should be able to formulate a complete presentation in which all key aspects should be highlighted and require conveying the scientific message to the audience appropriately within the given time frame.</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Scientific writing: 70%
Presentation: 30%</td></tr>
<tr><td colspan="2">References</td><td colspan="5">Reputed Journals and Conferences Papers mainly IEEE Xplora digital Liabraray</td></tr>
</table>

Semester-2: Power Electronic Designs (Compulsory Module)

<table>
<tr><td>Module Code</td><td>EE9133</td><td>Module Title</td><td colspan="4">POWER ELECTRONIC DESIGNS</td></tr>
<tr><td>Credits</td><td>3</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>40</td><td rowspan="2">Co-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>15</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">To provide knowledge and necessary skills for carrying out reliable designs of modern power electronic converter systems.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">At the end of this module the students will be able to
1. Practice reliable designs of power circuits of different topology
2. Design a regulated switching DC power supply for given specifications
3. Exhibit the knowledge of multilevel converter selection and design
4. Design a UPS system</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. General aspects of power electronic designs
2. Design of Switchmode DC power supplies
3. UPS and power conditioners
4. Multilevel converters</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Semester-end Examination: 70
Assignments: 20 and In class tests: 10</td></tr>
<tr><td colspan="2">References</td><td colspan="5">-</td></tr>
</table>

Semester-2: Network Management & Planning (Elective Module)

<table>
<tr><td>Module Code</td><td>ET9133</td><td>Module Title</td><td colspan="4">NETWORK MANAGEMENT & PLANNING</td></tr>
<tr><td>Credits</td><td>3</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>40</td><td rowspan="2">Co-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>15</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">To provide practical overview and implementation aspects on the network planning, implementation management, and forecasting of future requirements.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">After the completion of this module, the student should be able to achieve following outcomes
1. Plan an effective network, understanding the impact of the major capacity and coverage issues and the different technology choices.
2. Gain a solid foundation on which to plan and facilitate advanced technology projects – with higher competency levels bringing operational efficiencies, cost savings, and time-to-market advantage.
3. Use capacity modeling techniques to determine the overall system capacity and plan for future network expansion.
4. Fully understand and calculate link capacity under different radio channel conditions.
5. Build and calculate detailed link budgets for both Rural and Urban areas.
6. Compare and select typical propagation models used to predict cell range for radio links.
7. Use a capacity models to determine the likely requirements of a single subscriber.
8. Use dedicated coverage optimization software to explore the impact of specific parameter selections on the planning process.
9. Build the confidence to make decisions on technology implementation and procurement that are commercially viable, minimize risk, and in the strategy and goals of the wider organization.</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Introduction to Link Planning: Backhaul Link Requirements, Physical Layer Options , Radio and Fibre, Layer 2 design, MPLS, Ethernet, Architecture for Backhaul Networks, Base link Planning Processes.
2. Reliability and Redundancy: Quality and Reliability, Causes of Unavailability, ITU G.821 and G.826 Performance, Objectives, Planning for reliability, Redundancy options.
3. Radio Link Equipment: Radio Equipment Characteristics, Configurations, Primary Multiplex, Secondary Multiplex, Modems, Transceivers.
4. Propagation and Antennas, Microwave Propagation: Atmospheric Effects, Free-Space Propagation, Power Budgets, Fading, Antenna Considerations, Antenna Performance, Antenna Section.
5. Frequency Planning for Radio Links, Frequency Planning, Causes of Interference, Effects of Interference, Channel Planning, Frequency Re-use, Spectrum Availability, Spectrum Requirements for short and long links.
6. Margin Planning for Radio Links: Links Design, Multipath Fading, Multipath Outages, Rain Fade, Diversity Countermeasures, Reflection Analysis, Using Margins in the Link Budget.
7. Link Planning Exercise: Case Study Outline, Setting Performance Objectives, Planning to Financial KPLs, Equipment Selection, Practical Calculations and Modeling.
8. Link Budgets for LTE: Defining link budget reference points, EiRP , IRL, Setting coverage objectives, LTE link budget, Parameter definitions, CINR, Rx Threshold, Noise, Worked examples, Environmental margins, Fading, building,</td></tr>
</table>

	noise rise, Determining cell radius from pathloss, Propagation models, Common empirical and physical models, Model comparisons, Worked examples, UE Radio Measurements, Limitations of RSRP and RSRQ for Optimization, Formulation of RSRQ and RSRQ Performance Targets, LTE Measurement Tools. 9. Coverage Planning(In this section an appropriate software may be used to demonstrate coverage planning, this will involve hands-on exercises to demonstrate the planning process and analysis of the prediction output): Setting up the planning project , Single frequency network, Interference coordination, Multiple channel system, MIMO, Interference analysis, Capacity and coverage analysis. 10. Capacity Planning for LTE: LTE radio interface capacity, Factors affecting capacity, Setting capacity objectives, The EPS Bearer Concept, LTE Defined QoS Values, Defining a subscriber profile, Network design based on capacity. 11. Coverage Optimization (In this section coverage optimization will be discussed and after a hands on exercises using the above selected software): Identifying optimization targets, Managing optimization processes, Running optimizations, Analyzing optimization results.
Method of Assessment	Semester-end Examination: 70 Assignments: 30
References	-

Semester-1: Information Security & Cryptography (Compulsory Module)

<table>
<tr><td>Module Code</td><td>ET9143</td><td>Module Title</td><td colspan="4">INFORMATION SECURITY & CRYPTOGRAPHY</td></tr>
<tr><td>Credits</td><td>3</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>40</td><td rowspan="2">Co-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>15</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">The main objective is to provide the student knowledge of cryptography and information security and the application of cryptography in different networks.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">At the end of the course student should be able to
1. Gain the knowledge of cryptography
2. Gain the knowledge of information security
3. Gain the knowledge of implementation of information security in different platforms</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Introduction to types of security risks, Basics of Modern Cryptography,
2. Conventional encryption, Public key cryptography, Digital Signatures, Hashing and message digests, Authentication and public key infrastructure,
3. Network security, Bank cards and terminals, Electronic passports, RFID systems in public transportation and automobiles, Smart cards and mobile phone security, Payment systems and e-cash, E-auction, e-voting, e-betting and e-gambling</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Semester-end Examination: 70
Assignments: 30</td></tr>
<tr><td colspan="2">References</td><td colspan="5">1. Bruce Schneier (Oct 18, 1996). Applied Cryptography
2. David Basin, Patrick Schaller and Michael Schläpfer (Oct 27, 2011) Applied Information Security: A Hands-on Approach</td></tr>
</table>

Semester-2 Elective Module: Medical Electronics and Biomedical Instrumentation

Module Code	BM9113	**Module Title**	MEDICAL ELECTRONICS AND BIOMEDICAL INSTRUMENTATION			
Credits	3	**Hours/Week**	**Lectures**	40	**Co-requisites**	-
GPA/NGPA	GPA		**Lab/Assig.**	15		
Module Objectives		The main objective is to provide the student knowledge of medical electronics and biomedical instrumentation				
Learning Outcomes		After the completion of this module, the student should be able to 1. End of the course student will be able to gain the knowledge of human physiology 2. will gain the knowledge of medical electronics 3. will able to gain the knowledge of biomedical instrumentation and clinical measurements				
Outline Syllabus		1. Cell physiology, systems physiology, action potential feedback systems and modulation 2. Physiological measurements 3. Electrical based ,Imaging and tomography based and mechanical pulse based monitoring 4. Analog and digital electronics for Bio medical systems 5. Biomedical sensors 6. Diagnostic Biomedical technology and instrumentation 7. Ultrasound 8. ECG, EEG, EEG, EMG 9. MRI and clinical measurements 10. Radiation Techniques, PET and CT X-ray imaging 11. Safety and Clinical measurements 12.				
Method of Assessment		Presentations on Medical instrumentation topics and projects Semester-end Examination: 70 Assignments: 30				
References		1. John G. Webster (Feb 3, 2009). Medical Instrumentation Application and Design 2. David Prutchi and Michael Norris (Nov 22, 2004) . Design and Development of Medical Electronic Instrumentation: A Practical Perspective of the Design, Construction 3. Stuart Fox (Aug 27, 2010). Human Physiology				

Semester-3 & 4 Compulsory (for MSc) Module: Dissertation

<table>
<tr><td>Module Code</td><td>EE9999</td><td>Module Title</td><td colspan="4">DISSERTATION</td></tr>
<tr><td>Credits</td><td>20</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td></td><td rowspan="2">Co-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>1 Year</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">To provide students an opportunity to carryout an in-depth study of a selected topic and prepare a logically and comprehensively argued paper.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">1. To develop students' ability to carryout a detailed study on a subject and critically analyze relevant areas making use of the learnt concepts/techniques.
2. To apply Engineering concepts and techniques learnt and make use of them to find solutions.
3. To develop and apply independent thinking, originality and mastery of subject matter.
4. To define new conclusions through combining information from various sources on subjects not previously studied or widely known.</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">Reference Document: Guidelines to dissertation, Annex A</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Reference Document: Guidelines to dissertation, Annex A</td></tr>
<tr><td colspan="2">References</td><td colspan="5">Reference Document: Guidelines to dissertation, Annex A</td></tr>
</table>