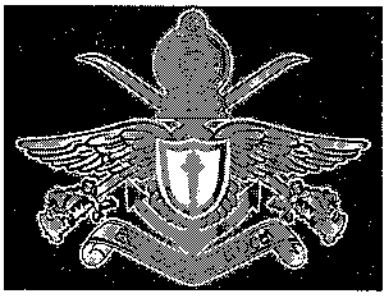
Degree of Master of Science and Postgraduate Diploma in Electrical Engineering

Faculty of Engineering

Genaral Sir John Kotelawala Defence University



By-Law

for the awards of the

Degree of Master of Science in Electrical Engineering

and

Postgraduate Diploma in Electrical 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.

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Genaral Sir John Kotelawala Defence University

Eligibility and Performance Criteria

for the awards of the

Degree of Master of Science in Electrical Engineering

and

Postgraduate Diploma in Electrical 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 Semesters

4.3 The maximum duration for PG Diploma is three years

4.4 The maximum duration for MSc is four 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.

CURRICULUM & SYLLABI

MSc/PG Diploma in Electrical Engineering

Department of Electrical, Electronic and Telecommunication Engineering

Faculty of Engineering

MSc/PG Diploma in Electrical 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
EE9043	Advanced Power Systems	3	40	15
EE9053	Controlled Drives	3	40	15
EE9062	Energy Efficiency, Demand Mgt & Conservation	2	30	0
Optional				
ET9072	Artificial intelligence Techniques	3	40	15
EE9073	Renewable Energy Development	3	40	15
		20	350	120

Semester 2				
EE9113	Operation Research	3	40	15
EE9122	Research Methodology II	2	30	
EE9133	Power Electronic Designs	3	40	15
EE9143	Smart Technologies in Power Systems	3	40	15
EE9153	Design Aspects of Electrical Installations	3	40	15
Optional				
ET9143	Information Security and Cryptography	3	40	15
EE9163	Microcontrollers, PLCs & Embedded Systems	3	40	15
EE9183	Energy Economics	3	40	15
		20		
EE9999	Dissertation	20		
	Total	60		

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">????</td></tr>
</table>

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

<table>
<tr><td>Module Code</td><td>EE902 2</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">????</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: Advanced Power Systems (Compulsory Module)

<table>
<tr><td>Module Code</td><td>EE9043</td><td>Module Title</td><td colspan="4">ADVANCED POWER SYSTEMS</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 equip the students with necessary methodologies and techniques to analyze and make appropriate decisions in power system planning and operation.</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. Exhibit broad knowledge on power system planning
2. Manage electricity production cost through proper unit commitment and economic dispatch
3. Analyze and evaluate system stability and propose action for improvement
4. Analyze and evaluate power system reliability and formulate strategies to improve reliability</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Long term system planning: Dimensions of system planning, objectives, complexities, practical approaches
2. Unit commitment: fuel constraints, reserve requirements, solution methods
3. Economic dispatch: first and second order gradient methods, Lagrange iteration method, transmission losses
4. Power system stability: Steady state stability, transient stability, sub-synchronous oscillations, analysis and improvements, voltage stability
5. Power system reliability analysis: Basic concepts of continuous distribution approximation, frequency balance approach, composite system reliability evaluation and discrete convolution method.</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Semester-end Examination: 70%
Assignments: 20%
Other Criteria (In class tests) 10%</td></tr>
<tr><td colspan="2">References</td><td colspan="5">????</td></tr>
</table>

Semester-1: Controlled Drives (Compulsory Module)

<table>
<tr><td>Module Code</td><td>EE9053</td><td>Module Title</td><td colspan="4">CONTROLLED DRIVES</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 and making wise selections of modern drive systems for different applications.</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. Select correct type & rating of motor and drive system for a given application
2. Carry out tests on a motor for efficiency class complying with standards
3. Design and simulate a complete speed/position controlled drive system of modern technology
4. Design starting and protection subsystems for a drive</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Selection of motors and motor drives
2. Energy efficiency labeling of motors
3. Modern speed controlled drives
4. Positioning drives
5. Starting and protection of motor drives</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>
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Semester-1: Energy Efficiency, Demand Management & Conservation (Compulsory Module)

<table>
<tr><td>Module Code</td><td>EE9062</td><td>Module Title</td><td colspan="4">ENERGY EFFICIENCY, DEMAND MANAGEMENT & CONSERVATION</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">To provide knowledge on energy supplies and manage energy use in cost effective manner.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">The students would be able to
1. Understand energy supply and demand structures of countries/installation/production processes
2. Analyze energy flows from primary energy sources to final end user categories
3. Understand the energy transformations, final energy utilization processes, and energy substitutions
4. To be a key member of an energy management team to undertake energy audits and energy management</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">The following topics will be covered.
1. Review basic concepts in thermodynamics, electricity and associated units
2. Energy statistics, interpretations and energy balances
3. Development of energy flow diagrams from primary sources to major economic sectors and for production processes/buildings
4. Energy auditing
5. Energy conservation techniques and enhancement of energy efficiencies
6. Energy management</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">????</td></tr>
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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">????</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. Describe four schools of thoughts in Artificial Intelligence
2. Apply Turing Test for determining machine intelligence
3. Distinguish between Machine Learning and Cognitive Systems
4. Identify major techniques in Artificial Intelligence
5. Determine suitability of AI techniques for selected real world problems
6. 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-1: Renewable Energy Development (Elective Module)

<table>
<tr><td>Module Code</td><td>EE9073</td><td>Module Title</td><td colspan="4">RENEWABLE ENERGY DEVELOPMENT</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 familiarize the learner with renewable energy sources and technologies in the world and give him a deeper knowledge on the renewable energy technologies widely used in Sri Lanka.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">1. Renewable energy history, classifications, Causes of global warming
2. Technology wise renewable energy growth in the world and in Sri Lanka, policies, targets
3. Renewable energy technologies
4. Renewable energy usage for non power applications,
5. Barriers for development
6. What future holds for renewable energy</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Introduction to Renewable Energy:•Classifications, Conventional Renewable Energy (CRE), Non Conventional Renewable Energy (NCRE), New Renewable Energy (NRE), History and issues caused by conventional energy generation technologies, Global warming.
2. Renewable energy development: Global status and government energy policies targets and initiatives.
3. Renewable energy development in Sri Lanka; Present status and Standard Power Purchase Agreement (SPPA), tariffs
4. Renewable energy technologies: Introduction to Small hydro, Wind, solar PV, Solar thermal, Biomass (Dendro, biogas), Geothermal, Wave, and Ocean Thermal technologies; Capital and Unit costs, Economic viability, Environmental costs, Comparison with conventional technologies
5. Renewable Energy technologies widely used in Sri Lanka for power generation and Detailed study of Small hydro , wind, Solar PV, Biomass based power plants
6. Non power generation applications and Renewable energy sources used by industry, households, hotel and the bakery sector.
7. Barriers for renewable energy development: Grid connection issues, high capital costs of equipment, conversion efficiency limitations, energy storage limitations and costs, low plant factors.
8. Future of the renewable energy development: Technological breakthroughs, New technologies for electricity storage, Reduction in the capital costs</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. Microwave transistor Amplifiers – Analysis and Design; Guillermo Gonzales, Prentice-Hall, Inc., Second Edition, ISBN: 0 13 254335 4
2. Antenna Theory - Analysis and Design; John Wiley & Sons, Inc., Second Edition, ISBN: 9971 51 233 5
3. Optical Networks; Rajiv Ramaswami & Kumar N Sivarajan, A Hartcourt Asia PTE Ltd, ISBN: 1 55860 445 6
4. Introduction to Radar Systems; Merrill I Skolnik, Tata McGraw-Hill, Second edition, ISBN: 0 07 057909 1</td></tr>
</table>

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

<table>
<tr><td>Module Code</td><td>EE9113</td><td>Module Title</td><td colspan="4">OPERATION RESEARCH</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 optimization & operation research to solve advanced engineering problems</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">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</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">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</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">Taha, Hamdy A (2002), Operations Research, 7th ed., Pearson Education, (CD-ROM Tora included)</td></tr>
</table>

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: Smart Technologies in Power Systems (Compulsory Module)

<table>
<tr><td>Module Code</td><td>EE9143</td><td>Module Title</td><td colspan="4">SMART TECHNOLOGIES IN POWER SYSTEMS</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 equip the student in the emerging technologies in SMART Power 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. Recognize the implementation of communication backbone upon the traditional power system.
2. Understand the nodal connectivity protocols residing on communication network layer
3. Understand the expert ware operating above the protocol layer implementing smart grid
4. Relate the traditional power system knowledge of reliability and security with the operation of the expert ware over the network connectivity obtained through communication backbone.
5. Appreciation of the advanced technologies such as self-healing networks, heuristic decision making protocols and flow control protocols.
6. Understand the FACT based technologies in power flow controls and reliability controls</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Introduction to Power System Security and Reliability
2. Smart Grid Protocols
3. Introduction to Expert Systems
4. Concentric Relaxation Technologies related to security enhancement
5. Introduction to FACT technologies</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">????</td></tr>
</table>

Semester-2: Design Aspects of Electrical Installations (Compulsory Module)

<table>
<tr><td>Module Code</td><td>EE9153</td><td>Module Title</td><td colspan="4">DESIGN ASPECTS OF ELECTRICAL INSTALLATIONS</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 give comprehensive knowledge to the students on electrical designs, installation, commissioning and energizing on practical point of view.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">1. To identify major electrical components in a building
2. To get a knowledge on other services in the building and coordinate the parameters with them
3. To read architectural drawings and structural drawings accurately
4. Designing of complete installation system in a commercial, factory, house buildings on practical point of view.
5. Practical installations of each category such as transformers, bus bars, DB etc
6. Problems/issues encountered in an installation while in construction
7. Testing & commissioning and Energizing and handing over to client</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Introduction
Types of buildings categorized under Electro-mechanical aspects, Architectural plans, grid numbering system, elevations, Different services to be incorporated in a commercial building
2. Cables: types of cables, advantages / disadvantages, Selection of cables for different types of applications, Methods of laying, bending, jointing, glanding, termination and earthing, Cable rises and their pulling methodology & Cable pulling in the ground, Busbar risers and horizontal busbar trunking system
3. Advantages/ disadvantages over the cable system, Different ratings, installation, tappings and other connection accessories (elbows, flanges, and caps etc.).
4. Distribution Boards
Different types of D/Boards and their mounting methods, types of enclosures, Selection & Internal wiring with usage of MCCB, ACB, MCB, RCCB, EFR, PFR etc, Designing of Electrical Distribution panel Boards and their protection schemes, Design and installation of capacitor bank units for commercial installations
5. Final sub circuit point wring Design of lamp points & power t points wiring through ring / radial circuits, Design and installation of Horizontal busbar trunking system for load wiring
6. Economic Quantitative Estimates for electrical installation, Activity Schedules and Disbursement Forecast of installation contracts, Labour handling
7. Earthing network in the building and Testing and commissioning of the installation</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">IEE regulations 16&17 editions, ICTAD documents etc.</td></tr>
</table>

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

<table>
<tr><td>Module Code</td><td>ET9032</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: 80
Assignments: 20</td></tr>
<tr><td colspan="2">References</td><td colspan="5">Bruce Schneier (Oct 18, 1996). Applied Cryptography
David Basin, Patrick Schaller and Michael Schläpfer (Oct 27, 2011). Applied Information Security: A Hands-on Approach</td></tr>
</table>

Semester-2: Microcontrollers, PLCs and Embedded Systems (Elective Module)

<table>
<tr><td>Module Code</td><td>EE9163</td><td>Module Title</td><td colspan="4">MICROCONTROLLERS, PLCS AND EMBEDDED SYSTEMS</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">????</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">1. To tie together the computer engineering curriculum via the design of a complete embedded system comprising hardware, software, and communication components.
2. To learn how to evaluate tradeoffs in technical design.
3. To develop a complete product from design to implementation to debugging.
4. To gain appreciation for software issues in embedded systems.
5. To understand basic microcontrollers and how to use them in embedded system design.
6. To gain familiarity with basic serial and parallel communication methods.</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Introduction to embedded systems: Introduction to Embedded System, History, Design challenges, optimizing design metrics, time to market, applications of embedded systems and recent trends in embedded systems, embedded design concepts and definitions, memory management, hardware and software design and testing, communication protocols
2. Microcontrollers: Microprocessors and microcontrollers – (Basic organization, Address /data bus , Memories , I/O ports , Timing subsystems , Interrupt handling), Interfacing techniques – (Basic I/O ports, Interactions involving time , Memories ,Interface support devices , Polling , Interrupts and interrupt), Communication Methods – (Serial ,Parallel, Basic wireless schemes , Error correction, Flow control)
3. System Architecture : The 8051 Architecture- Hardware- Oscillator and clock, program counter, datapointer, registers stack and stack pointer , special function registers, memory organization, program memory, data memory, Input / Output Ports , External memory counter and timer, serial data Input / output Interrupts, Introduction to PIC 16F & 18F family ICs - Microcontroller Core Features , Timers Capture/Compare/PWM Modules ,Master Synchronous Serial Port (MSSP) Module ,Addressable Universal Synchronous Asynchronous Receiver Transmitter (USART) ,Analog-to-Digital Converter (A/D) Module
4. PIC Programming in Mikro C: PIC I/O Port Programming , PIC Hardware Connection and ROM loaders, Timers Programming , Serial Port Programming ,Interrupt Programming ,LCD and Keypad Interface , USB communication , ADC and DAC , Sensor and other Applications, Introduction to Circuit Simulation (Introduction to Easy PIC6 and program the Various type of PIC and debug the programs using real hardware components
5. Real time operating system concept: Architecture of kernel, task scheduler, ISR, Semaphores, mailbox, message queues, events, memory management, RTOS services in contrast with traditional OS. Introduction to Ucos II RTOS, study of kernel structure of Ucos II, synchronization in Ucos II, Inter-task communication in Ucos II, memory management in Ucos II, porting of RTOS. Microcontroller software issues- Interrupt handling , Device drivers, Multi-tasking , Operating systems for embedded applications
6. Current trends in Microcontrollers: Programmable logic controllers (PLCs) , Introduction of Raspberry-Pi and programming using Python , Introduction to Arduino , various types of ArduinoSheilds , and programing using ArduinoIDE</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Continuous assessment (20%)
Final written exam (80%)</td></tr>
<tr><td colspan="2">References</td><td colspan="5">????</td></tr>
</table>

Semester-2: Energy Economics (Elective Module)

<table>
<tr><td>Module Code</td><td>EE9183</td><td>Module Title</td><td colspan="4">ENERGY ECONOMICS</td></tr>
<tr><td>Credits</td><td>3</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>36</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>18</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">To equip the students with necessary methodologies and techniques to analyze and make appropriate decisions in energy related issues.</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. Exhibit broad knowledge on energy sector, both local and global
2. Analyze energy policies and design new policies to achieve preset objectives
3. Analyze demand patterns and conduct demand forecasting
4. Compare different supply side options and conduct cost benefit analysis of energy projects
5. Evaluate power sector restructuring efforts and analyze different electricity market structures</td></tr>
<tr><td colspan="2">Outline Syllabus</td><td colspan="5">1. Energy sector and its importance in local and global scenario
2. Demand analysis, determinants of demand
3. Different methods in demand forecasting
4. Economic comparison of supply side energy options, direct and indirect costs
5. Economic and financial cost-benefit analysis
6. Power sector restructuring, electricity market structures.</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Semester-end Examination: 70%
Assignments: 20% and Other Criteria (In class tests) 10%</td></tr>
<tr><td colspan="2">References</td><td colspan="5">????</td></tr>
</table>

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>