CURRICULUM & SYLLABI

Department of Electrical Engineering

Table of Contents

B.Sc. Engineering Honours Curriculum

Electrical Engineering

Module Code	Module Name	Category	Lectures	Lab/ Assgnmt	Credits		Norm		
			hrs/week	hrs/week	GPA	NGPA	GPA	NGPA	Total
Semester 1									
MA1012	Mathematics	C	3	1/1	3.0				
CS1032	Programming Fundamentals	C	2	3/1	3.0				
ME1032	Mechanics	C	2	3/4	2.0				
MT1022	Properties of Materials	C	2	3/4	2.0				
CE1022	Fluid Mechanics	C	2	3/4	2.0				
EE1012	Electrical Engineering	C	2	3/4	2.0				
EL1012	Language Skill Enhancement I	C	-	3/1	1.0		**15.0**		**15.0**
Terms A1 and A2									
EL1022	Language Skill Enhancement II	C	-	6/1	1.0				
DE1xx2	Non-Technical Option I	C	2	6/1	2.0		**3.0**		
MN1012	Engineering in Context	C	2	-		1.0			
EE1952	Engineering Design	C	2	3/1		1.5			
EE1962	Skill Development	C	1	6/1		1.5		**4.0**	**7.0**
Semester 2									
MA1022	Methods of Mathematics	C	3	-	3.0				
EE2292	Theory of Electricity	C	2	-	2.0				
EE1032	Electromagnetic Field Theory	C	2	-	2.0				
EN2022	Digital Electronics	C	2	3/2	2.5				
EN1052	Introduction to Telecommunications	C	2	-	2.0				
CS2842	Computer systems	C	2	-	2.0				
ME1802	Introduction to Manufacturing Engineeri	C	1	3/1	2.5				
EE1092	Laboratory Practice II	C	-	3/1	1.0		**17.0**		**17.0**
Semester 3									
MA2012	Differential Equations	C	2	-	2.0				
MA2022	Calculus	C	2	-	2.0				
EE2012	Circuit Theory	C	2	-	2.0				
EE2022	Electrical Machines and Drives I	C	2	-	2.0				
EE2032	Power Systems I	C	2	-	2.0				
EN2012	Analog Electronics	C	2	3/2	2.5				
CS2812	Visual Programing	C	2	-	2.0				
ME 2012	Mechanics of Materials I	C	1.5	3/2	2.0				
CE1822	Aspects of Civil Engineering	C	2	1	2.0				
EE2092	Laboratory Practice III	C	-	3/1	1.0		**19.5**		
	Optional from CSE/ENTC/MECH	O	2	-	2.0				**19.5**
Semester 4									
MA2032	Linear Algebra	C	2	-	2.0				
MA2042	Discrete Mathematics	C	2	-	2.0				
EE2042	Electrical Measurements and Instrumentation	C	2	-	2.0				
EE2052	Control Systems I	C	2	1	2.0				
EE2062	Electrical Installations I	C	2	-	2.0				
EE2072	Electrical Machines and Drives II	C	2	-	2.0				
EE2082	Power Systems II	C	2	-	2.0				
EE2192	Laboratory Practice IV	C	-	3/1	1.0				
ME2852	Basic Thermal Sciences and Applications	C	3	-	3.0				
EE3202	Individual Project	C	2	-	2.0		**20.0**		
									20.0

Semester 5									
MA3012	Applied Statistics	C	2	-	2.0				
MA3022	Numerical Methods	C	2	-	2.0				
MN3042	Business Economics and Financial Accounting	C	3	-	3.0				
EE3012	High Voltage Engineering I	C	2	-	2.0				
EE3022	Control Systems II	C	2	-	2.0				
EE3032	Electrical Machines and Drives III	C	2	-	2.0				
EE3042	Power Systems III	C	2	-	2.0				
EE3052	Power Electronics and Applications I	C	2	-	2.0				
EE3062	Energy Systems	C	2	-	2.0				
EE3092	Laboratory Practice V	C	-	3/1	1.0		**20.0**		
	Optional from CSE/ENTC/MECH	O	2	-	2.0				
EE3902	Communication and Presentation Skills	C	1.5	-		1.5		**1.5**	**21.5**
Semester 6 & Term B									
EE 3992	Industrial Training	C	-	-				**6.0**	**6.0**
Semester 7									
MN3052	Industrial Management and Marketing	C	3		3.0				
MN 4122	Technology Management	E*	2	-	2.0				
MN 3042	Engineering Economics								
EE4012	Automation and Control Technologies	C	2	-	2.0				
EE4022	High Voltage Engineering II	C	2	-	2.0				
EE4032	Electrical Installations II	C	2	-	2.0				
EE4042	Electrical Machines and Drives IV	C	2	-	2.0				
EE4052	Power Systems IV	C	2	-	2.0				
EE4202	Design Project	C	-	-	5.0				
EE4092	Laboratory Practice VII	C	-	3/1	1.0				
	Optional from CSE/ENTC/MECH	O	2	-			**21.0**		
EE4902	Field Visit		-	2/2		1.0		**1.0**	**22.0**
Term C									
DE30x2	Non-Technical Option II	CE	2	4/1			**2.0**		**2.0**
Semester 8									
MN4072	Small Business Management and Entrepreneurship	E*	2	-	2.0				
MN4092	Management Skills Development								
MN4122	Human Resource Management and Ind. Relations								
EE4062	Power Electronics and Applications II	C	2	-	2.0				
EE4072	Computer Aided Design & Simulation	C	1.5	3/2	2.0				
EE4082	Robotics and Mechatronics	C	2	-	2.0				
EE4202	Design Project	C	-	-	5.0				
EE4192	Laboratory Practice VIII	C	-	3/1	1.0		**14.0**		**14.0**
EE4702	Renewable Energy and the Environment	O	2	-	2.0				
EE4712	Realtime Computer Systems	O	2	-	2.0				
MA4022	Operations Research	O	2	-	2.0				
MA4032	Time Series & Stochastic Process	O	2	-	2.0		**6.0**		**6.0**
							137.5	**12.5**	**150.0**
							GPA	**NGPA**	**Total**
E*	One of these 5 electives must be taken in either Sem. 7 or 8								
Service Course offered (Sem 3 or 4)									
EE2802	Applied Electricity		1.5	3/2	2.0				

Detailed Syllabi – Electrical Engineering

Module Code	EE1012	Title	Electrical Engineering				
Credits (GPA)	**2.0**	**Hours/Week**	**Lectures**	**1.5**	**Pre – requisites**	**None**	
			Lab/Tutorials	**3/2**			

Learning Outcomes

After completing this module the students should be able to

1. use correct SI units
2. project an overall picture of Electrical Engineering
3. perform DC, AC and transient calculations
4. apply different types of meters for electrical measurements
5. draw up complete wiring circuit of a household and appreciate the importance of different protection

Outline Syllabus

1. SI Units
2. Overview of Electrical Engineering
3. Basic DC circuit analysis: Circuit elements, circuit laws, circuit solutions
4. Transient solution of simple RLC circuits
5. AC Theory: Phasor representation, complex representation, impedance, admittance, complex power and energy, power factor, AC circuit calculations
6. Electrical Measurement: Moving coil, moving iron and rectifier type meters, bridge methods, power and energy meters, working principles
7. Electrical Installations: Fuses, MCBs, ELCBs, wires, complete household wiring circuit

<table>
<tr><td>Module Code</td><td>EE1952</td><td>Module Title</td><td colspan="4">Engineering Design</td></tr>
<tr><td>Credits</td><td>1.5</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2</td><td rowspan="2">Pre – requisites</td><td rowspan="2">Semester 1 modules</td></tr>
<tr><td>GPA/NGPA</td><td>NGPA</td><td>Lab/Assignments</td><td>03/1</td></tr>
</table>

Learning Outcomes

After completing this course, the students should be able to,

1. demonstrate the ability to understand Design Principles
2. demonstrate the ability to understand various aspects of design in several selected design case studies.
3. carrying out a group based product design assignment addressing issues such as manufacturability, marketability, creativity, team work, meeting deadlines.

Outline Syllabus

1. Design principles

- Introduction to Engineering Design
- Life Cycle of Engineering Products and Processes
- Design process and Design Tools
- Concurrent Engineering
- Creativity and Reasoning
- Analysis, synthesis, simulation, evaluation and decision making

2. Case studies

Several simple but comprehensive design case studies selected from different disciplines of engineering addressing following topics:

- Design for manufacturing
- Mechanical and material aspect in design
- Electrical, Electronic and IT aspects in Design

3. Design assignments

Group based design assignments

The project will include (a) gathering of data and information from various sources as a preliminary to the design, (b) preparing a work plan and delegating duties, (c) working with others and to produce results by given deadlines and within given costs, (d) learning the basic procedures required for conceptual, preliminary and detailed designs, (e) learning the importance of the cost component in the manufacturing process, (f) preparing a report and making a presentation on the work done, (g) demonstrating the working of the prototype.

<table>
<tr><td>Module Code</td><td>EE1962</td><td>Module Title</td><td colspan="4">Skill Development</td></tr>
<tr><td>Credits</td><td>1.5</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>1.0</td><td rowspan="2">Pre-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>6/1</td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. model and construct simple products based on the knowledge and skills of AutoCAD, PSPICE, drawing and workshop.

Outline Syllabus

1. Use of basic skill development tools: AutoCAD, PSPICE, workshop, drawing.
2. Group report and presentation on the use of skill development tools.

<table>
<tr><td>Module Code</td><td>EE2292</td><td>Module Title</td><td colspan="4">Theory of Electricity</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisite</td><td rowspan="2">EE1092</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. solve coupled circuits involving mutual impedance and/or resonance phenomena.
2. apply network theorems in solving circuits.
3. solve circuits containing three phase generators and loads.
4. analyse circuits with non-sinusoidal voltage and current waveforms.

Outline Syllabus

1. **Review of fundamentals**
   Fundamentals of electric circuits, DC circuit analysis, Transient solutions of RLC circuits using differential equations, AC theory.

2. **Coupled circuits and Dependent sources**
   Series and parallel resonance, mutual inductance, electromagnetic coupling in circuits, analysis of coupled circuits, transformer as a coupled circuit; Dependent sources, solving of circuits in the presence of dependent sources.

3. **Network theorems**
   Superposition, Thevenin's, Norton's, Millman’s, Reciprocity, maximum power transfer, Nodal-mesh transformation and compensation theorems. Network topology, Nodal and mesh analysis. Two-port theory: Impedance, admittance, hybrid and ABCD parameters.

4. **Three-phase Analysis**
   Analysis of three phase balanced circuits and unbalanced circuits, symmetrical components, Single line equivalent circuits.

5. **Non-sinusoidal waveforms (6 hrs)**
   Waveform parameters: rms, peak, rectified average etc., power, harmonics, Fourier analysis, Laplace transform, transient analysis using the Laplace transform.

<table>
<tr><td>Module Code</td><td>EE1032</td><td>Module Title</td><td colspan="4">Electromagnetic Field Theory</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisite</td><td rowspan="2">EE1092</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. solve electrostatic and electromagnetic field problems involving simple conductor configurations.
2. apply fundamental concepts of electromagnetic waves and their relationship to electric circuits.

Outline Syllabus

1. **Electrostatic theory**
   Electric charge and electric field, Coulomb’s law, Gauss’s theorem and its use for electric flux density and electric field calculations, Electric potential due to charges, Laplace’s and Poisson’s equations, Solution to Laplace’s equation for determining potential distribution, The interface between two dielectric media, Method of images, Capacitance of conductor configurations with two or more conductors, Energy in electric fields, Calculation of mechanical force due to electrostatic fields.

2. **Electromagnetic theory**
   Production and measurements of magnetic fields, Magnetic potential, Magnetomotive force, Biot-Savart and Ampere laws for calculating magnetic potential and flux density for simple conductor configurations, Magnetisation of iron, Design calculations for magnetic circuits, air-gap flux, flux leakage. Electromagnetic induction, Faraday’s law, Energy in magnetic fields, Calculation of mechanical force due to magnetic fields.

3. **Electrodynamics**
   Motion of charged particles in the presence of electrostatic and electromagnetic fields.

4. **Maxwell's equations**
   The field equations in the quasi-stationary case, concepts of displacement current, the complete field equations in differential and integral forms, Maxwell's equations in the case of sinusoidal variations.

5. **Plane electromagnetic waves**
   Wave equation and its solution in the single dimensional case, plane waves in dielectric space with and without losses, concepts of wave impedance, impedance of empty space, power flow, Poyntin's theorem. Electromagnetic waves at boundaries, Continuity condition, Conditions at a perfect conductor, Electromagnetic waves in conductors.

<table>
<tr><td>Module Code</td><td>EE1092</td><td>Module Title</td><td colspan="4">Laboratory Practice II</td></tr>
<tr><td>Credits</td><td>1.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>None</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>3/1</td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. use instruments correctly and appropriately for measuring electrical quantities.
2. appreciate and apply electrical safety procedures.
3. demonstrate knowledge of elementary electrical devices which are based on electromagnetic and electrostatic principles.

Outline Syllabus

This module consists of Semester 2 Electrical Engineering Laboratory experiments in the areas of,

1. Electrical measurements
2. Electric circuits
3. Electrostatic fields
4. Electromagnetic fields

Experiments may cover more than one area and would be conducted as part of a system.

<table>
<tr><td>Module Code</td><td>EE2012</td><td>Module Title</td><td colspan="4">Circuit Theory</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE2092</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. derive network functions for a given circuit and thereby understand the circuit properties.
2. simulate a circuit using computer software.
3. synthesis networks and filter circuits.

Outline Syllabus

1. **The s-plane**
   The general complex exponential excitation function; Network functions; Pole-zero patterns; properties of LC, RC and RLC network functions; energy functions.

2. **Introduction to the state-space representation**
   The selection of state variables, transformations, canonical forms.

3. **Computer aided circuit simulation**
   DC and AC circuit simulation using SPICE, circuit description using netlist, text based simulation, graphical simulation tools.

4. **Synthesis of passive networks**
   Synthesis of LC, RC, & RLC networks; Cauer, Foster canonical forms and other methods.

5. **Classical filter design**
   Impedance matching, low pass, high pass and band pass filters; basic sections; Modern filter design: Butterworth and Tschebycheff approximations etc., frequency transformations; Active filter design.

<table>
<tr><td>Module Code</td><td>EE2022</td><td>Module Title</td><td colspan="4">Electrical Machines and Drives I</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE2092</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes :

After completing this module the student should be able to

1. select the most suitable types of materials for a given machine design
2. demonstrate the knowledge of electromechanical energy conversion principles
3. identify applications that need DC motors, DC generators, or single phase transformers and apply them
4. do basic design of a single phase transformer
5. solve operational problems in DC motors and single phase transformers
6. perform calculations of DC motors, DC generators and single-phase transformers

Outline Syllabus

1. **Materials in electrical machines**
   Properties of different grades of iron, permanent magnets, special alloys, conductors, insulation materials and superconductors, Atomic magnetism, magnetization curve, magnetic losses, ferro-fluids, Design with permanent magnets.

2. **Electromechanical energy conversion**
   Energy balance equation, Principles and production of force/torque in linear and rotary coupled circuits, Stationary and rotating magnetic fields, Overall relationship between machine dimensions and power, specific electric and magnetic loading.

3. **DC machines**
   Construction and operating principle, separate, shunt, series and compound excited motors, steady state equivalent circuit and characteristic, dynamic behaviour, speed control, starting, braking, applications.

4. **Single-phase transformers**
   Construction, equivalent circuit, testing, characteristic, parallel operation, autotransformers, pulse transformers, high frequency equivalent circuit.

Module Code	EE2032	Module Title	Power system I			
Credits	2.0	**Hours/Week**	**Lectures**	2.0	**Co-requisites**	EE2092
GPA/NGPA	GPA		**Lab/Assignment**			

Learning Outcomes

After completing this module the student should be able to

1. compare the role, functions and the structure of Sri Lanka's power system with those of other developed/developing countries and to analyze its performance in the light of global trends.
2. demonstrate knowledge of energy conversion technologies to generate electricity and assess their advantages, disadvantages and effects on environment.
3. demonstrate knowledge of the characteristics and construction of underground and overhead transmission systems, their effects on environment and human life.
4. perform calculation of transmission line parameters and evaluate the performance characteristics of the transmission system.
5. design a simple distribution system taking into consideration the basic concepts in distribution system design.
6. design an overhead line for a power system to comply with standards.

Outline Syllabus

1. **Introduction to power systems**

   Present scenario in energy, global and local trends. Development, structure and management of the electric power system in Sri Lanka**.**

2. **Power generation technologies**

   Fossil fuel-based generating systems (coal steam, oil steam, diesel, gas turbine, combined cycle, combined heat and power). Nuclear Energy Systems, nuclear fuel cycle, types of reactors. Hydro electric systems - storage, run-of-river, micro/mini, pumped storage. New and renewable energy systems - wind, solar thermal, solar photovoltaic, wave, tidal, OTEC, geothermal - current status of development and future potential. Environmental and ecological considerations, safety issues. Economic comparison of power generation systems.

3. **Power transmission systems**

   Overhead and underground systems, conductor and cable types, insulating materials, line construction and accessories. Environmental, safety and health issues. Insulators: Types, electrical and mechanical specifications. String voltage distribution.

4. **Transmission line parameters**

   Calculation of transmission line parameters; resistance, inductance, capacitance for solid, stranded and bundled conductors. Transposition. Short, medium and long line models and calculations, Ferranti effects, shunt and series compensation. Circle diagrams, line power limits. Introduction to network planning and optimization.

5. **Power distribution**

   Overhead and underground systems, feeders and distributors, ring and radial systems, distribution substations, principles of electricity tariff, tariffs in Sri Lanka, end use equipment, introduction to demand management and conservation of electricity.

6. **Mechanical characteristics of lines**

   Mechanical Characteristics of Overhead Lines: Choice of route, types of towers, conductor spacing and configuration. Sag and span calculations, sag templates, stringing charts.

<table>
<tr><td>Module Code</td><td>EE2092</td><td>Module Title</td><td colspan="4">Laboratory Practice III</td></tr>
<tr><td>Credits</td><td>1.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>None</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>3/1</td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. appreciate and apply electrical safety procedures.
2. demonstrate knowledge of electrical machines as applied in the industry.
3. demonstrate knowledge of power systems as applied in the industry.

Outline Syllabus

This module consists of Semester 3 Electrical Engineering Laboratory experiments in the areas of,

1. Electric circuits
2. Electrical machines I
3. Power systems I

Experiments may cover more than one area and would be conducted as part of a system.

<table>
<tr><td>Module Code</td><td>EE2042</td><td>Module Title</td><td colspan="4">Electrical Measurements and Instrumentation</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE2192</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. design analogue and/or digital instruments for electrical measurements.
2. use digital and/or analogue oscilloscope effectively.
3. analyse signals for measuring purposes.

Outline Syllabus

1. **Sensors and Transducers**
   Review of analogue instrumentation, null deflection methods, current and potential transformers. Types of sensors/transducers for measurements of physical quantities.

2. **Sampled data systems**
   Nyquist's sampling theorem, encoding, modulation, quantising, resolution, dynamic range, quantisation noise; Fourier analysis of sampled data, aliasing, antialiasing filters.

3. **Digital instrumentation**
   Analogue-to-digital conversion (ADC), digital-to-analogue conversion (DAC), real-time data acquisition, hardware and software for data acquisition, digital multimeters, data loggers.

4. **Oscilloscope**
   Analogue oscilloscope: electron deflection, time base generation, focusing, modes of operation; Digital oscilloscope: sample rate and bandwidth, data storage, display, on-screen measurements.

5. **Statistical basis of measurements**
   Statistical signal analysis, correlation, convolution, Kalman filtering.

<table>
<tr><td>Module Code</td><td>EE2052</td><td>Module Title</td><td colspan="4">Control Systems I</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE2192</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

At the end of this module the student should be able to

1. derive mathematical models of a variety of electrical, mechanical, and electro-mechanical systems.
2. compare the open loop and closed loop (feedback) systems
3. understand the concept of stability of a dynamic system
4. draw the pole-zero diagram and the root loci, which are the change in location of the poles as parameters are of a system are varied.
5. use frequency response methods and frequency domain techniques to design controllers.
6. estimate time response of systems to impulse, step, ramp, and sinusoidal inputs from the transfer function.
7. identify the importance of three term (PID) controllers
8. use Matlab® with facility to aid in the analysis and design of control systems.
9. construct simple feedback circuits using op-amps.

Outline Syllabus

1. **Introduction to control systems**
   Historical Background and examples of control system applications, Open-loop Versus Closed-loop Control, On-off and hysteresis band control ,Basic Components of a Control System ,
   Analog Control Versus Digital Control ,Analog versus digital implementation, DSPs in control systems, Continuous Control Versus Discrete Control and PLCs

2. **Modeling of systems**
   Differential equation of physical systems, Linear versus nonlinear systems, Laplace transforms, transfer functions and block diagrams, block diagram simplification, state variable models.

3. **Feedback control systems**
   Open and closed loop control systems, transient response, disturbances steady state errors, cost of feedback, test input signals, performance of a second order systems, time response, stability, steady state error.

4. **Root Locus Techniques**
   Definition, Properties, and Sketching Rules. Design via Root Locus. Three term (PID) controllers.

5. **Frequency Response Techniques**
   Frequency response plots, sketching rules, Bode Plots, Design via Frequency Response

6. **Stability in the frequency domain**
   Mapping contours in the S plane, Nyquist criterion, system bandwidth, stability with time delays, PID controller in frequency domain, stability in frequency domain using MATLAB.

Module Code	EE2062	Module Title	Electrical Installation I			
Credits	2.0	Hours/Week	Lectures	2.0	Co-requisites	EE2192
GPA/NGPA	GPA		Lab/Assignment			

Learning Outcomes

After completing this module the student should be able to

1. demonstrate the understanding of the structure of the IEE Wiring Regulations and apply it for electrical installation designs.
2. distinguish the characteristics of different types of protective devices used in Electrical Installations, their principle of operation, advantages and disadvantages.
3. assess the general characteristics of an electrical installation and differentiate among electrical wiring systems in Domestic, Commercial and Industrial applications.
4. select correct type and size of cables in electrical installations.
5. select the earthing system for a particular electrical installation at medium voltages.
6. design electrical layouts and wiring diagrams for electrical installations according to the given environmental conditions.
7. draw up complete wiring circuit using CAD package.
8. use technical documents in electrical installations and prepare technical documents involved in electrical installations.
9. carry out inspection and testing in electrical installations.

Outline Syllabus

1. **Introduction to Wiring Regulations**
   Structure of the 17th Edition of the IEE Wiring Regulations (BS 7671: 2008), its importance and applicability to Sri Lanka.

2. **Types of electrical earthing systems**
   TT, TN, IT systems and their features, commonly used grounding arrangements.

3. **Electrical safety and protective measures**
   Protection against electric shock, protective equipment and conductors. Protection systems adopted in wiring systems. Electrical Safety measures.

4. **Design criteria of electrical installations**
   Assessment of general characteristics of an electrical installation, Demand calculation and diversity. Sizing and selection of cables, accessories, current rating of cables, voltage drop, temperature dependence, steps in the design of a small electrical installation.

5. **Wiring design using CAD (**
   Use of a software package for electrical wiring design.

6. **Technical documents**
   Preparation and use of: Tender documents, technical specifications and drawings, BOQs, contract documents.

7. **Inspection, testing and certification**
   Earth resistivity measurements, ground resistance calculations, continuity and insulation testing, polarity checking
   Basic Testing and commissioning of electrical installations, preparation of test reports.

<table>
<tr><td>Module Code</td><td>EE2072</td><td>Module Title</td><td colspan="4">Electrical Machines and Drives II</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE2192</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the students should be able to

1. compare performance of different types of three-phase transformers and induction motors and select the most suitable type for a given application.
2. choose the most suitable starting, braking, or speed control equipment for a three-phase induction motor for a given application.
3. compare performance of different types of single phase AC motors and select the most suitable motor.
4. perform calculations of steady state behaviour three-phase transformers, three-phase induction motors and single-phase motors .

Outline Syllabus

1. **Three-phase transformers**
   Construction of different types, vector group, per-unit equivalent circuit, characteristic, losses and efficiency, magnetization phenomena, unbalanced loading, parallel operation, tap changing, inrush current

2. **Three-phase induction motors**
   Squirrel cage rotor and wound rotor types, equivalent circuits, torque-speed characteristics, losses and efficiency, NEMA classes, testing, starting, braking, principles of speed control, operation as a generator, motor applications.

3. **Single-phase motors**
   Induction motors of different types, equivalent circuit calculations, torque-speed characteristic, methods of speed control, applications, AC commutator motor (universal motor).

<table>
<tr><td>Module Code</td><td>EE2082</td><td>Module Title</td><td colspan="4">Power system II</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE2192</td></tr>
<tr><td>GPA/NGPA</td><td></td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. calculate the short circuit currents for balanced and unbalanced faults in a power system.
2. demonstrate knowledge of the general requirements of protective relaying.
3. select suitable instrument transformers for metering and protection, optimization of their protection functions.
4. demonstrate knowledge of relaying principles of electro-mechanical, static and numeric relays.
5. design protection schemes using over current, earth fault and directional relays and to calculate the relay settings.
6. design appropriate protection schemes for generators and transformers.
7. apply electromechanical, static and numeric distance relays for protection from distance faults.
8. analyze relay records and determine the cause of failure after a protective relay operation.

Outline Syllabus

1. **Fault analysis**
   Causes and effects of faults. Review of per unit system and symmetrical components. Symmetrical three-phase faults. Unsymmetrical faults, short circuit and open circuit conditions. Introduction to simultaneous faults
2. **Introduction to power system protection**
   Necessity for protection, Historical development, General requirements of protective relaying, Unit and non unit protection, primary and backup protection
3. **Instrument transformers**
   Current and voltage transformer: principles and applications, steady state operation, equivalent circuit, errors, accuracy limits and classes of CTs and VTs, transient response of CTs.
4. **Types of relays and relaying principles**
   Operating principles of electro-mechanical, static and numeric relays. Basic structure of protection systems, rated current, voltage and setting of relays, operation of basic relay types.
5. **Relay coordination**
   Principles of over current protection, discrimination by time, current, time and current, inverse characteristics, discriminative grading, characteristic presentation, earth fault detection, sensitive earth fault protection, theory and operation of directional over current, earth fault relays and their applications.
6. **Transformer and Generator protection**
   Types of transformer faults, principles of transformer protection, generator faults, principles of generator protection.
7. **Distance protection**
   General principles, relationship between primary and secondary impedance, zones, distance relay performance, distance relay inputs, switched and non switched distance relays, characteristic presentation, numeric distance relays, distance relay schemes with co-ordination of communication facilities.
8. **Busbar and feeder differential protection**
   Application of Merz-Price principle, current balance and voltage balance schemes, summation current transformers, differential relay performance, numeric feeder differential relays, basic requirements and types of busbar protection schemes, introduction to slow and high speed auto reclosing, failure analysis.

<table>
<tr><td>Module Code</td><td>EE2192</td><td>Module Title</td><td colspan="4">Laboratory Practice IV</td></tr>
<tr><td>Credits</td><td>1.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>None</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignemnt</td><td>3/1</td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. appreciate and apply electrical safety procedures.
2. demonstrate knowledge of control systems as applied in the industry.
3. demonstrate knowledge of electrical installations as applied in the industry.
4. demonstrate knowledge of electrical machines as applied in the industry.
5. demonstrate knowledge of power systems as applied in the industry.

Outline Syllabus

This module consists of Semester 4 Electrical Engineering Laboratory experiments in the areas of,

1. Electrical measurements
2. Control systems I
3. Electrical installations I
4. Electrical machines II
5. Power systems II

Experiments may cover more than one area and would be conducted as part of a system.

<table>
<tr><td>Module Code</td><td>EE3202</td><td>Module Title</td><td colspan="4">Individual Project</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td></td><td rowspan="2">Pre-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>6/1</td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. plan and design an engineering project independently, adopting a system approach.
2. identify sources of data, components and standards.
3. apply standard software for engineering solutions.

Outline Syllabus

1. Design of an engineering product or system individually and independently.
2. Complying with Financial, environmental and social requirements.
3. Presentation of results.

<table>
<tr><td>Module Code</td><td>EE3012</td><td>Module Title</td><td colspan="4">High Voltage Engineering I</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE3092</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

At the end of the module, the student should be able to

1. demonstrate understanding of the polarization of a medium.
2. select materials for applications based on the properties of the dielectric.
3. calculate the occurrence of lightning in transmission lines based on the isokeraunic level.
4. identify the losses occurring in cables and calculate the same.
5. carry out a theoretical design of a cable based on minimising its stress distribution.
6. determine the current rating of a cable based on its thermal behaviour.

Outline Syllabus

1. **Dielectric Materials**
   Polarization of a medium. Free and bound charges in a capacitor. Relationship between electric field, polarization, displacement, permittivity and susceptibility. Thermal classification of dielectrics. Properties and selection of dielectric materials.
2. **Breakdown of Gaseous Insulation**
   Ionisation of Gases: Ionisation and breakdown processes in gases. Time lags of Spark breakdown. Corona Discharges: Mechanism of corona formation and Power Loss.
3. **Breakdown of Liquid and Solid Insulation**
   Breakdown in Liquids: Breakdown of Commercial liquids; Breakdown due to gaseous inclusions, liquid globules, solid particles. Purification of a liquid for testing. Breakdown of Solid Insulating Materials. Breakdown of Composite Insulation.
4. **Lightning Phenomena**
   Mechanism of Lightning: Frequency of occurrence of lightning flashes. Lightning Problem for Transmission Lines. Shielding by overhead ground wires. Effects of Lightning on a Transmission Line.
5. **High Voltage Cables**
   Power loss in the cable. Impregnated paper insulation. Insulation Resistance, Capacitance, Copper Space Factor. Dielectric stress in a single core cable: Cable Grading for Uniform Stress Distribution. Pressurised high voltage cables. Thermal design of cables:. High voltage bushings.

<table>
<tr><td>Module Code</td><td>EE3022</td><td>Module Title</td><td colspan="4">Control Systems II</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE3092</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

At the end of this module the student should be able to,

1. model, simulate, and control of SISO/MIMO linear/nonlinear systems.
2. compare and contrast variety of control techniques with respect to a given control problem.
3. design, implement, and evaluate controllers for SISO/MIMO linear/nonlinear systems.
4. examine the use, theoretical and implementation aspects, and potential of computer-based control and modern control techniques.

Outline Syllabus

1 **State-Space Methods**

Introduction, solution of the state equation, state-transition matrix, characteristic equation and the eigenvalues, stability and the eigenvalues ,controllability and observability, observer design, state feedback control ,state feedback with integral control ,canonical forms.

2 **Digital Control**

Background, analog versus digital control , mathematical methods of discrete systems, the z-transform, discrete time transfer function, stability, modified Routh's criterion, design of digital control systems.

3 **Nonlinear Control**

Linear vs nonlinear systems, linearized systems, Lyapunov-based methods, stability using Lyapunov method, phase-plane method, feedback linearizing control.

4 **Intelligent and Adaptive Control**

Neurocontrol: Radial basis function (RBF) NNs ,multi-layer perceptron (MLP) NNs, Identification-based indirect control ,Design examples. Fuzzy Logic Control (FLC): The three-step process of generating FLCs, Fuzzy PID control, Design examples. Adaptive Control: Conventional adaptive control, Adaptive PID control, Neuroadaptive control.

Module Code	EE3032	Module Title	Electrical Machines and Drives III			
Credits	2.0	**Hours/Week**	**Lectures**	2.0	**Co-requisites**	EE3092
GPA/NGPA	GPA		**Lab/Assignment**			

Learning Outcomes :

After completing this module the students should be able to

1. operate a large generator and vary its output power within safe limits
2. bring in a generator parallel with another
3. perform calculations of steady state behaviour of AC generators
4. design a DC motor drive system for one, two or four quadrant operation.
5. distinguish between conventional and brushless DC drive options in terms of cost and performance.
6. select the best DC drive system for a given application to meet specified performance standards.
7. compare performance of different types of stepper motors and select the most suitable type for a given positioning application.
8. identify essential operational constraints in stepper motors and design drive systems to comply with them.
9. perform calculations of DC drives, brushless DC drives, stepper drives and switch reluctance drives.

Outline Syllabus

1. **Synchronous generators for bulk generation**
   Cylindrical rotor and salient pole rotor types, constructional features, windings, cooling, excitation, equivalent circuit, phasor diagram, power-angle characteristic, safe operation, turbine-governor characteristic, real power control, reactive power control, AVR, parallel operation, synchronizing, earthing.

2. **DC motor drives**
   One, two and four quadrant drives using Power Electronic converters of different types, closed loop and open loop control, servo drives and adjustable speed drives, transient over current, implementation of dynamic and regenerative braking, soft starting, motor-converter coordination,

3. **Brushless DC motor drives**
   Trapezoidal and sinusoidal types of motors, construction, principle of operation, drive system, performance calculation, open and closed loop control, multi-quadrant operation.

4. **Stepper motor drives**
   Types of stepper motors and their constructions, stepping sequence, torque characteristic, dynamic performance, operational constraints, drive systems, unipolar and bipolar excitation, closed loop operation (switch reluctance motor).

<table>
<tr><td>Module Code</td><td>EE3042</td><td>Module Title</td><td colspan="4">Power system III</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE3092</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. perform load flow analysis on power systems using different techniques.
2. demonstrate knowledge of power system stability, factors that influence system stability and methods to improve and maintain stability.
3. select switchgear for power system giving due consideration to their characteristics and ratings.
4. design a grounding system for a power substation.

Outline Syllabus

1. **Load flow analysis**
   Mathematical techniques of load flow analysis, real and reactive power flow calculations, tightly/loosely coupled networks, contingency analysis.

2. **Power system stability** (
   Steady state stability: Power angle characteristics, swing equation, effect of AVR and governor. Transient stability: Equal area criterion, stability under fault conditions, step by step solution of swing equation. Voltage stability.

3. **Switchgear**
   Types of switchgear. Fault clearing and interruption of currents, making and breaking capacities, arc formation, methods of quenching, re-striking and recovery voltage transients. Principle of operation, indoor and outdoor types, miniature circuit breakers; oil, air, vacuum, Sulphur hexafluoride and air blast circuit breakers, use of GIS package.

4. **System grounding and substation earthing**
   Ungrounded, effectively grounded, resistance grounded and resonant grounded systems. Neutral earthing. Step and Touch potentials. Grounding of delta connected systems, design of grounding systems.

<table>
<tr><td>Module Code</td><td>EE3052</td><td>Module Title</td><td colspan="4">Power Electronics and Applications I</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE3092</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes :

After completing this module the students should be able to

1. select the most appropriate power switching devise for a given design.
2. assemble single and three phase ac to dc converters and test them.
3. identify problems of harmonics and distortions at ac input due to the operation of ac to dc converters and take corrective measures.
4. construct different types of dc to ac inverters and apply them selectively to solve practical problems.
5. develop control circuits/software to operate an inverter in given PWM, or square switching mode.
6. perform calculations in ac to dc and dc to ac converters and ac voltage regulators.

Outline Syllabus

1. **Power semiconductor switching devices**
   Overview of Power Diodes Thyristors, BJTs, MOSFETs, IGBTs and other hybrid devices, switching characteristics, ratings, drive circuits.

2. **AC to DC converters**
   Single and three phase converters using diodes and /or thyristors, effects of smoothing capacitor, operation with inductive loads, control of output voltage, line notching, inverted operation, margin-angle.

3. **DC to AC inverters**
   Single and three-phase voltage source inverters, square-wave and different PWM types, implementation, harmonics, output filtering, voltage and frequency control, applications.

4. **AC voltage regulators**
   Static ac voltage regulators for low and high power applications.

<table>
<tr><td>Module Code</td><td>EE3062</td><td>Module Title</td><td colspan="4">Energy Systems</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After the completion of the course the student should be able to

1. identify the primary energy sources, their limitations and costs.
2. assess the world/Sri Lanka energy demand and the demand growth.
3. understand the different energy conversion processes, their efficiencies and associated economics.
4. appreciate the necessity of energy policies in the international level as well as at the individual country level.
5. understand the Sri Lanka energy policy.
6. evaluate the relationship between economic development and energy. Energy as a catalyst to all sectors of a macro economy.
7. appreciate the importance of energy planning, energy management, energy economics and pricing.

Outline Syllabus

1. **Introduction**
   Conventional Energy Resources: Major hydro, Coal, Oil, Natural gas, Uranium; Major reserves, Depletion rates.
   Non Conventional Energy Resources: Small hydro, Solar, Wind, Biomass, Tidal, Geothermal; Their limitations, Barriers for commercial deployment
2. **Energy Consumption / Demand**
   Energy consumption in developed and developing countries, regional consumption patterns, sectoral consumption, per capita consumption. Global/Sri Lanka Demand for energy, Demand growth patterns and forcasts, Energy and the economy.
3. **Energy Conversion Processes**
   Primary conversion processes, Oil refining, Gasification of coal and bio fuels, Energy Conversion processes at end use, their efficiencies, costs of conversion.
4. **Energy Policy**
   Energy policy by world energy council, Energy policy in Sri Lanka.
5. **Energy Planning / Energy Management**
   Energy data bases, Development of an energy balance, Integrated energy planning, Supply side and Demand side energy management.
6. **Energy Economics**
   Economic comparison of energy supply systems, Energy Pricing, Financial and economic cost-benefit analysis of energy sector projects.
7. **Environmental Concerns**
   Environmental impacts of energy projects and related costs. Regulatory requirements, International protocols, Carbon Trading.

Module Code	EE3092	**Module Title**	Laboratory Practice V			
Credits	1.0	**Hours/Week**	**Lectures**	None	**Pre-requisites**	None
GPA/NGPA	GPA		**Lab/Assignment**	3/1		

Learning Outcomes

After completing this module the student should be able to

1. appreciate and apply electrical safety procedures.
2. demonstrate knowledge of high voltage equipment and systems as applied in the industry.
3. demonstrate knowledge of control systems as applied in the industry.
4. demonstrate knowledge of power electronic drives as applied in the industry.
5. demonstrate knowledge of electrical machines as applied in the industry.
6. demonstrate knowledge of power systems as applied in the industry.

Outline Syllabus

This module consists of Semester 5 Electrical Engineering Laboratory experiments in the areas of,

1. High voltage I
2. Control systems II
3. Power electronics and Applications I
4. Electrical machines III
5. Power systems III

Experiments may cover more than one area and would be conducted as part of a system.

<table>
<tr><td>Module Code</td><td>EE3902</td><td>Module Title</td><td colspan="4">Communication and Presentation Skills</td></tr>
<tr><td>Credits</td><td>1.5</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>1.5</td><td rowspan="2">Pre-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. read critically and analyze the content to locate the important points
2. develop reports that present ideas clearly and systematically
3. compose technical papers in standard formats
4. present a given topic clearly through oral presentations with and without multimedia support
5. decide on the appropriate content and the length of the presentation
6. engage the audience with the presentation
7. review speeches and presentations in front of an audience.

Outline Syllabus

1. Critical reading of technical literature and summarizing contents
2. Report writing, Technical non-technical
3. Design and development of presentations
4. Question and Answer sessions based on the presentation
5. Evaluation of presentations
6. Debates and discussions

<table>
<tr><td>Module Code</td><td>EE3992</td><td>Title</td><td colspan="4">Industrial Training</td></tr>
<tr><td>Credits</td><td>6.0</td><td rowspan="2">Hours/Week
24 weeks full time</td><td>Lectures</td><td></td><td rowspan="2">Pre-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>NGPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. identify how the theoretical principles learnt as an undergraduate could be applied practically
2. demonstrate the skills, knowledge and attitudes needed for an effective start of the engineering profession
3. work with different categories of people in an industrial environment
4. adopt appropriate technical, environmental, economic and social constraints
5. demonstrate knowledge of organizational, financial and human resource management

Outline Syllabus

1. Induction from academic to industrial life
2. Practical Skills in planning, design, Installation, commissioning and maintenance
3. Interaction with superiors and subordinates
4. Teamwork and responsibility
5. Safety practice
6. Systems approach
7. Management

<table>
<tr><td>Module Code</td><td>EE4012</td><td>Module Title</td><td colspan="4">Automation and Control Technologies</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE4092</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. decide whether a certain process should be automated or not based on Technical, Economical and Social facts.
2. Identify the steps involved in practical automation.
3. apply the knowledge gained in a real automation exercise.
4. assess future trends and needs of automation

Outline Syllabus

1. **Introduction**
   Devices used in Automation, Coils, Contacts, Timers and Counters, Logical Program Development, Other Sensors and Actuators, Safety in Industrial Automation, Economics of automation

2. **Actuator Systems**
   Components, Proportional and Servo Valves; Pneumatic Control Systems : System Components, Controllers ;

3. **Architecture of Industrial Automation Systems**
   Process Control: P-I-D Control, Controller Tuning, Special Control Structures: Feed forward and Ratio Control, Predictive Control, Control of Systems with Inverse Response, Cascade Control

4. **Sequence and digital Control**
   PLCs and Relay Ladder Logic, Scan Cycle, RLL Syntax, Structured Design Approach, Hardware environment; DSPs.

5. **Integration of Sensors, Actuators and Controllers.**

6. **Introduction to Production Control Systems**

7. **Social Aspects and future trends of Automation**

Module Code	EE4022	Module Title	High Voltage Engineering II			
Credits	2.0	**Hours/Week**	**Lectures**	2.0	**Co-requisites**	EE4092
GPA/NGPA	GPA		**Lab/Assignment**			

Learning Outcomes

At the end of the module, the student should be able to

1. analyse transients in high voltage transmission lines.
2. measure high voltages used for testing and do calibrations on testing equipment.
3. observe high voltage fast transients on an oscilloscope without distortion.
4. calculate the dielectric constant and dissipation factor of dielectrics.
5. analyse circuits producing high voltages for testing purposes.
6. apply alternating, direct and impulse high voltages to equipment under test.
7. co-ordinate impulse insulation levels in the transmission system.

Outline Syllabus

1. **High Voltage Transient Analysis**
   Surges on Transmission Lines: Surge Impedance and Velocity of Propagation, Reflection and Transmission of Travelling waves, Bewley Lattice Diagram. Representation of Lumped Parameters. Digital computer implementation. Transform Methods of solving Transients.
2. **Measurement of High Voltage**
   Direct Measurement of High Voltages: Electrostatic Voltmeters, Sphere gaps. Transformer and potential divider methods of measurement. Matching of Potential dividers. Measurement of Surges. General measurements: Peak reading voltmeters, Oscilloscope for measurement of fast transients. Measurements of capacitance permittivity and dissipation factor. Detection of internal discharges.
3. **High Voltage Generators for Testing**
   Generation of High Alternating Voltages: Cascade arrangement of transformers, Resonant Transformers. Generation of High Direct Voltages: Rectifier circuits, Voltage Multiplier Circuits, Electrostatic generators.
4. **High Voltage Surge Generators**
   High Voltage Impulse Generators: Single exponential waveform, Double exponential waveform, Calculation of coefficients from resistance and capacitance values. Definition of Wavefront and Wavetail times of practical waveforms. Operation of the Marx Impulse Generator. Generation of chopped impulse waveforms.
5. **High Voltage Testing**
   General tests carried out on High voltage equipment. Testing of solid dielectric materials. Type tests, Sample Tests, Routine Tests. Tests on typical high voltage equipment.

<table>
<tr><td>Module Code</td><td>EE4032</td><td>Module Title</td><td colspan="4">Electrical Installation II</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE4092</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. carry out a lighting design for a building environment.
2. practice safety regulations & standards and behave in a safe manner in the electrical working environment.
3. apply lightning protection principles for an electrical installation.
4. use air conditioning, ventilation, Emergency lighting, fire detection and alarm systems.
5. manage resources of building environments.
6. distinguish different requirements of special installations.

Outline Syllabus

1. **Engineering Acoustics**
   Sound power, measurement, sound level estimation, sound pollution, noise control

2. **Artificial lighting and lighting design**
   Physics of illumination, vision and perception of colour, lamps and luminaries, lighting design by manual methods, lighting design software, lighting control and automation.

3. **Air conditioning, ventilation, fire detection and alarm systems**
   HVAC and fire safety, air conditioning, load calculations and design, ventilation systems, fire detection systems, alarm systems

4. **Building management systems**

<table>
<tr><td>Module Code</td><td>EE4042</td><td>Module Title</td><td colspan="4">Electrical Machines and Drives IV</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE4092</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes :

After completing this module the students should be able to

1. design and implement a three-phase induction motor drive system covering wide speed range
2. distinguish between adjustable speed and servo grade induction motor drives
3. identify components in an induction motor drive system and their functions
4. revise rating plate of a motor for new operating environment
5. select the kW rating of a motor to function in a known load cycle
6. perform temperature rise calculations for a motor operation
7. identify where and how to apply synchronous motor drives in industry
8. perform short circuit transient calculations to estimate generator parameters and select rating for the generator breaker

Outline Syllabus

1. **Three-phase induction motor drives**
   System structure, variable voltage variable frequency control, initial voltage boosting, high speed control, slip regulation and direct current limiting techniques, ramp limiters, independent flux and current control (field oriented control), closed loop drives, coordination between motor and power electronic inverter, voltage and current waveforms at low and high speeds, multi-quadrant operation.

2. **Operational aspects**
   Rating plate data, safe operation, temperature rise calculations, sizing of motors for given load cycles, general and special purpose motors.

3. **Synchronous motor drives**
   Large synchronous motor drives using load commutated inverters, self controlled synchronous motor drives.

4. **Transient performance of synchronous generators**
   Subtransient, transient, and steady state reactance and time constants, sudden short circuit current analysis, parameter estimation using short circuit oscillogram, sudden open circuit performance, slip test.

Module Code	EE4052	Module Title	Power systems IV			
Credits	2.0	Hours/Week	Lectures	2.0	Co-requisites	EE4092
GPA/NGPA	GPA		Lab/Assignment			

Learning Outcomes

After completing this module the student should be able to

1. contribute positively towards the operation of a power system with the understanding gained in the operation and control of power systems.
2. design an optimal operation setup for the power system whilst meeting the desired needs.
3. analyze the problems associated with the power industry in a country and be a knowledgeable participant in a team of regulators.
4. demonstrate the knowledge of methodologies used to evaluate generation, transmission and distribution system reliability and to plan power systems to meet the benchmarks on system adequacy, security etc.
5. model a power system using at least one industry recognized software and to carry out the basic studies. Carrying out the necessary studies and prepare reports.
6. demonstrate knowledge of power system stability phenomena and use the stability study results to improve power system performance.

Outline Syllabus

1. **Power system control**
   Load Control & Frequency Stability, Automatic Load Frequency Control, AVR and Voltage Control, Reactive Power Control. Dynamic model of a governor, different governors in power plants, primary load frequency control, concept of control area. AVR System, voltage profile & power transfer, voltage control of generators and droop settings, step up transformers and voltage injection.

2. **HVDC**
   High voltage direct current transmission over long distances.
3. **Power system economics**
   Economic operation of power systems: load dispatch with power system constraints, merit order dispatch, use of Lagrange multipliers and penalty factors.

4. **Power sector restructuring, regulation and competition**
   Need for restructuring of the electricity industry, alternative structures, types of regulation, relationship between competition and regulation, International and local experience.

5. **Planning and reliability**
   Introduction to long term planning, reliability, probabilistic production costing.

6. **Power system modelling**
   Dynamic model of Power System, ALFC Control, Control techniques (PI, PID, Modern Control), Synchronous and asynchronous interconnections, use of PSCAD for system modeling.

7. **System stability and load shedding**
   Effect on system stability by adding generators and loads, load shedding criterion and design of load shedding scheme.

<table>
<tr><td>Module Code</td><td>EE4202</td><td>Module Title</td><td colspan="4">Design Project</td></tr>
<tr><td>Credits</td><td>10.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td></td><td rowspan="2">Pre-requisites</td><td rowspan="2"></td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. design and implement an engineering project
2. develop specific skills in project definition, planning and scheduling
3. present technical ideas in written and oral form effectively
4. apply realistic constraints and engineering standards in a project
5. propose new ideas as needed to meet the goals of a project

Outline Syllabus

1. Design and develop a complete engineering project
2. Demonstrate and present the result

<table>
<tr><td>Module Code</td><td>EE4092</td><td>Module Title</td><td colspan="4">Laboratory Practice VII</td></tr>
<tr><td>Credits</td><td>1.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>None</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>3/1</td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. appreciate and apply electrical safety procedures.
2. demonstrate knowledge of high voltage equipment and systems as applied in the industry.
3. demonstrate knowledge of automation and control systems as applied in the industry.
4. demonstrate knowledge of power electrical installations as applied in the industry.
5. demonstrate knowledge of electrical machines as applied in the industry.
6. demonstrate knowledge of power systems as applied in the industry.

Outline Syllabus

This module consists of Semester 7 Electrical Engineering Laboratory experiments in the areas of,

1. High voltage II
2. Automation and Control Technologies
3. Electrical installations II
4. Electrical machines IV
5. Power systems IV

Experiments may cover more than one area and would be conducted as part of a system.

Module Code	EE4902	Module Title	Field Visits			
Credits	1.0	Hours/Week	Lectures		Pre-requisites	
GPA/NGPA	NGPA		Lab/Assignment			

Learning Outcomes

After completing this module the student should be able to

1. demonstrate the correlation between theory and its application
2. apply multidisciplinary approach to engineering projects
3. exhibit solidarity among student to emerge as a team

Outline Syllabus

1. Group visits to places such as power stations, switchyards, electrical installations, electrical manufacturing plants, renewable energy plants.
2. Preparation of report

Module Code	EE4062	**Module Title**	Power Electronics and Applications II			
Credits	2.0	**Hours/Week**	**Lectures**	2.0	**Co-requisites**	EE4192
GPA/NGPA	GPA		**Lab/Assignment**			

Learning Outcomes :

After completing this module the students should be able to

1. build different types of DC to DC converters and their control circuits
2. assemble multi stage power conversion systems involving all AC to DC converters.
3. carry out reliable designs of power electronic systems to meet given specifications.
4. carry out testing and troubleshooting of power electronic systems.
5. construct industry standard power electronic products and provide documentation.
6. apply power electronics to solve problems in such areas as power systems, process industries, motion control systems etc. And build products with commercial motives

Outline Syllabus

1. DC to DC converters

Isolated and non isolated converters of different types, output voltage regulation, steady state analysis, switch mode power supplies.

1. Design of power electronic converters

Selection of voltage and current ratings, deciding on switching frequency, protection of power devices against over voltage, over current, thermal buildup, switching stresses, spurious triggering, shoot-through fault etc., circuit protection, design of drive circuits, isolation of control signals, component selection, testing, circuit fabricating ethics, control circuit interface, use of power integrated circuits, application specific integrated circuits and programmable integrated circuits, product architecture, documentation.

2. Simulation of power electronic systems

Use of standard simulation packages.

3. Applications

Details of selected applications of power electronics in power systems, industrial processes, motion control systems, power supplies, artificial lighting etc.

Module Code	EE4072	**Module Title**	Computer Aided Design and Simulation			
Credits	2.0	**Hours/Week**	**Lectures**	1.5	**Pre-requisites**	None
GPA/NGPA	GPA		**Lab/Assignment**	3/2		

Learning Outcomes

After the completion of the module the student should be able to

1. use computer aided drafting packages for design and modelling of 2D/3D objects.
2. model dynamic behaviour of a physical system and simulate it on a digital computer.
3. design and analyse electrical circuits using circuit design and simulation packages.
4. solve numerical problems using numerical analysis packages.

Outline Syllabus

1. **Introduction**
   Why Computer Aided Design (CAD) and Computer Aided Simulations (CAS), Model designs, Optimum system configuration through CAD and CAS, Examples.
2. **Computer Aided Drafting**
   Introduction to computer aided spatial design, drawing primitives, creation of complex objects by combining primitives, model space, paper space, 2D/3D visualisation, real world problems.
3. **System Modelling**
   Classification of dynamic systems, Elements in electrical systems, mechanical systems, chemical systems, hydraulic systems and other non-linear systems.
4. **System Simulation**
   Computer aided simulations and available packages, Creating simulation environment for different problems, Creating data files from the simulation, data visualization.
5. **Circuit Simulation**
   Analysis and simulation of electrical circuits using a circuit simulation package. Steady state and transient analysis.

Laboratory Design Examples and Laboratory Assignments

<table>
<tr><td>Module Code</td><td>EE4082</td><td>Module Title</td><td colspan="4">Robotics and Mechatronics</td></tr>
<tr><td>Credits</td><td>2</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Co-requisites</td><td rowspan="2">EE4192</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. develop an understanding of the basic concepts involved in Robotics.
2. recognise the value of Integrated knowledge over several disciplines for the present day Robotics systems
3. design and fabricate a simple Robot/Mechatronics system

Outline Syllabus

1. **Introduction**
   History of Robotics and Mechatronics, Different disciplines of Robotics, What to be expected in the future.

2. **Kinematics and Kinetics of Machines**
   Practical movements in 2D/3D, Rigid motions and homogeneous transformation, Forward and Inverse Kinematics, Velocity Kinematics Jacobian

3. **Path and Trajectory Planning**

4. **Dynamics**

5. **Control and Sensing aspects in robotics and mechatronics**
   Sensors and Actuators for robotics, Introduction to Artificial Intelligence, Microprocessor based Controllers, Vision based controllers.

<table>
<tr><td>Module Code</td><td>EE4192</td><td>Module Title</td><td colspan="4">Laboratory Practice VIII</td></tr>
<tr><td>Credits</td><td>1.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>None</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>3/1</td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. appreciate and apply electrical safety procedures.
2. demonstrate knowledge of robotic and mechatronics as applied in the industry.
3. demonstrate knowledge of power electronics as applied in the industry.
4. demonstrate knowledge of power systems as applied in the industry.
5. demonstrate knowledge of electrical machines as applied in the industry.

Outline Syllabus

This module consists of Semester 8 Electrical Engineering Laboratory experiments in the areas of,

1. Robotics and Mechatronics
2. Power electronics and Applications II
3. Electrical machines IV
4. Power systems IV

Experiments may cover more than one area and would be conducted as part of a system.

Module Code	EE4702	Module Title	Renewable Energy and the Environment			
Credits	2.0	**Hours/Week**	**Lectures**	2.0	**Pre-requisites**	None
GPA/NGPA	GPA		**Lab/Assignment**			

Learning Outcomes

After the completion of the course the student should be able to

1. assess the environmental Impacts caused by indiscriminate operation of conventional energy supply systems.
2. appreciate the necessity to move towards sustainable energy resources with minimum impact on the environment.
3. evaluate the present status of renewable energy development in the world / Sri Lanka.
4. compare different non conventional renewable energy technologies, their efficiencies, resource assessment and capital as well as operational costs.
5. identify the barriers to commercial development of large scale renewable projects.

Outline Syllabus

1. **Environmental impacts of energy projects**
   Impacts of fossil fuel based energy systems on the environment and human life. Global warming. Extreme weather.
2. **Sustainable energy supplies**
   Sustainable and renewable energy sources and projects. Their impacts on the environment.
3. **Present status of renewable energy development**
   Global status of renewable energy technology development. Targets set by government energy policies and initiatives.
4. **Renewable energy technologies**
   Present day technologies used in harnessing Small hydro, Wind, Solar, Biomas, Geothermal, Tidal power etc. Resource assessment, the efficiencies of energy conversions, costs of development and operation.
5. **Battery technologies**
   Types of batteries, capacities, Specific energy densities, fuel cells, battery technologies for renewable options.
6. **Regulatory structure**
   Regulatory structure for developing renewable energy projects for electricity generation. Tariffs available for developers.Net metering.

<table>
<tr><td>Module Code</td><td>EE4712</td><td>Module Title</td><td colspan="4">Realtime Computer Systems</td></tr>
<tr><td>Credits</td><td>2.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>2.0</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td></td></tr>
</table>

Learning Outcomes

After completing this module the student should be able to

1. design a real-time control system for industrial control.
2. program and implement hardware necessary for real-time control.
3. design software for mission critical applications.

Outline Syllabus

1. **Real-time operating systems**
   Computer architecture, microprocessor programming, concurrency, interrupts, process management, memory management, virtual memory, input/output, deadlocks, synchronisation and mutual exclusion.

2. **Development of mission critical software**

3. **Hardware and software for industrial control**

4. **System integration**

Service Course (Semester 3)

Module Code	EE2802	**Module Title**	Applied Electricity			
Credits	2.0	**Hours/Week**	**Lectures**	1.5	**Pre-requisites**	EE1012
GPA/NGPA	GPA		**Lab/Assignment**	3/2		

Learning Outcomes

After completing this module the student should be able to

1. calculate electric transformer or motor performance under variety of load conditions,
2. select a suitable electric motor for a given application,
3. demonstrate basic knowledge in electricity utilisation in the areas of lighting, heating and welding,
4. understand wiring regulations applicable to households,
5. carry out simple voltage drop calculations for cables,
6. estimate monthly electricity bill for an installation and methods of minimising the cost of electricity.

Outline Syllabus

1. **Transformers**
   Single Phase transformers, EMF equation, equivalent circuit & phasor diagram, losses & efficiency, voltage regulation, test on transformers, use of three phase transformers.
2. **Induction motors**
   Types of rotors and windings, induction motor action, torque speed characteristics, losses and efficiency, starting and speed control, ratings and applications. single phase induction motors and their applications.
3. **D.C. machines**
   Equivalent circuits, motor and generator operation, characteristics of series, shunt and compound motors, starting and speed control, industrial applications.
4. **Special purpose motors**
   Universal motors: constructional and operational characteristics. Stepper motor operation and types, applications.
5. **Solid state control**
   Introduction to solid state control of dc and ac motors, principles of four-quadrant operation.
6. **Electric lighting**
   Basic principles, characteristics of light, lamps and luminaires, average lumen method of lighting calculations.
7. **Heating and welding**
   Methods of heating: Joules, induction and dielectric. Industrial applications. Electric welding: types, requirements, welding transformers.
8. **Electrical wiring**
   Wiring regulations, circuits and wiring symbols, selection and voltage drop calculations of cables. Earthing.
9. **Economics of power Utilisation**
   Cost of electric power: fixed, variable and maximum demand charges, tariffs. Demand management: power factor correction.