Department of Electrical Engineering

Undergraduate Handbook

University of Moratuwa
Katubedda, Moratuwa 10400
Sri Lanka

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Forward

The Department of Electrical Engineering of the University of Moratuwa, Sri Lanka, gladly welcomes you to be a part of this glorious seat of learning. As fresh undergraduates in Electrical Engineering you will be introduced to a highly stimulating intellectual environment with an interesting range of subjects during your stay in the Department. This handbook is aimed at providing you with relevant academic information which we hope you will find useful throughout your undergraduate career in the field of Electrical Engineering. The performance criterion, curriculum and the syllabi contained herein have been extracted from the respective documents approved for B.Sc. Engineering course by the Senate of the University of Moratuwa.

Learning is an enthralling experience. It does not entail the academic components alone. Learning and acquisition of knowledge best take place in a setting of cross disciplinary exposure. Our department is equipped to guide you through your stay here with a learning experience starting from fundamentals progressing gradually to most modern concepts in electrical engineering. These academic instructions are augmented with pragmatic sessions with the industrial partners and professional experts. We consider it equally important to assist you in personality development too before you graduate as a budding engineer. Therefore, the Department participate in a number of entertaining extra-curricular activities that are organized by the Electrical Engineering Society, in addition to sports and many other social activities conducted regularly by the University.

It is our sincere hope that you will make the maximum benefit out of the opportunity of belonging to a learned community of a prestigious institution. Do take time to read through the information and guidelines provided here and become familiar with the Department and its resources before you start in earnest.

We would like to acknowledge the support, academic guidance and the creative ideas received from the staff members of the Department in compiling this handbook.

Wish you an intellectually stimulating, personally rewarding and memorable time at the Department.

Contents

Welcome

It is with great pleasure and affection that I welcome you to the Department of Electrical Engineering as the new group of undergraduates in the current year. I congratulate your victory in securing a place in this department amidst tough competitions. From now on you are a valued member of this department with every right and freedom to enjoy its facilities, privileges and esteem.

The Department of Electrical Engineering in recent times has undergone significant changes and expanded its scope widely to accommodate new challenges in the century. A major expansion was done in the part of efficient utilization of electrical energy and the scope now covers the key areas of industrial motor drives, power electronics, electric transportation, artificial lighting, electrical construction, building services, system automation, intelligent systems, mechatronics, robotics etc. A comprehensive curriculum revision was also done in the area of generation, transmission and distribution of electrical energy. Utility management, renewable energy, energy sector forecasting and planning, product development, research and many other interdisciplinary areas were introduced and wide options are made available in the areas of IT, software and electronics.

In your academic program at Semester 2, we concentrate more on the fundamentals of Electrical Engineering. Core practices of Electrical Engineering are set from Semester 3 onwards. In semester 6 you will be sent for Industrial Training for 24 weeks and the knowledge and skill you acquire will be very useful to you specially to execute the group project in Semesters 7 and 8. You will undergo 12 weeks of compulsory training in CEB and LECO – an electrical utility company exposing yourself to electrical power systems operations and next 12 weeks at an Electrical Engineering facility. Field visits are arranged regularly at each level for you to witness the real side of Electrical Engineering practice in the presence of academic staff. The mentoring program at Level 3 and 4 will help you to strengthen your outlook and personality.

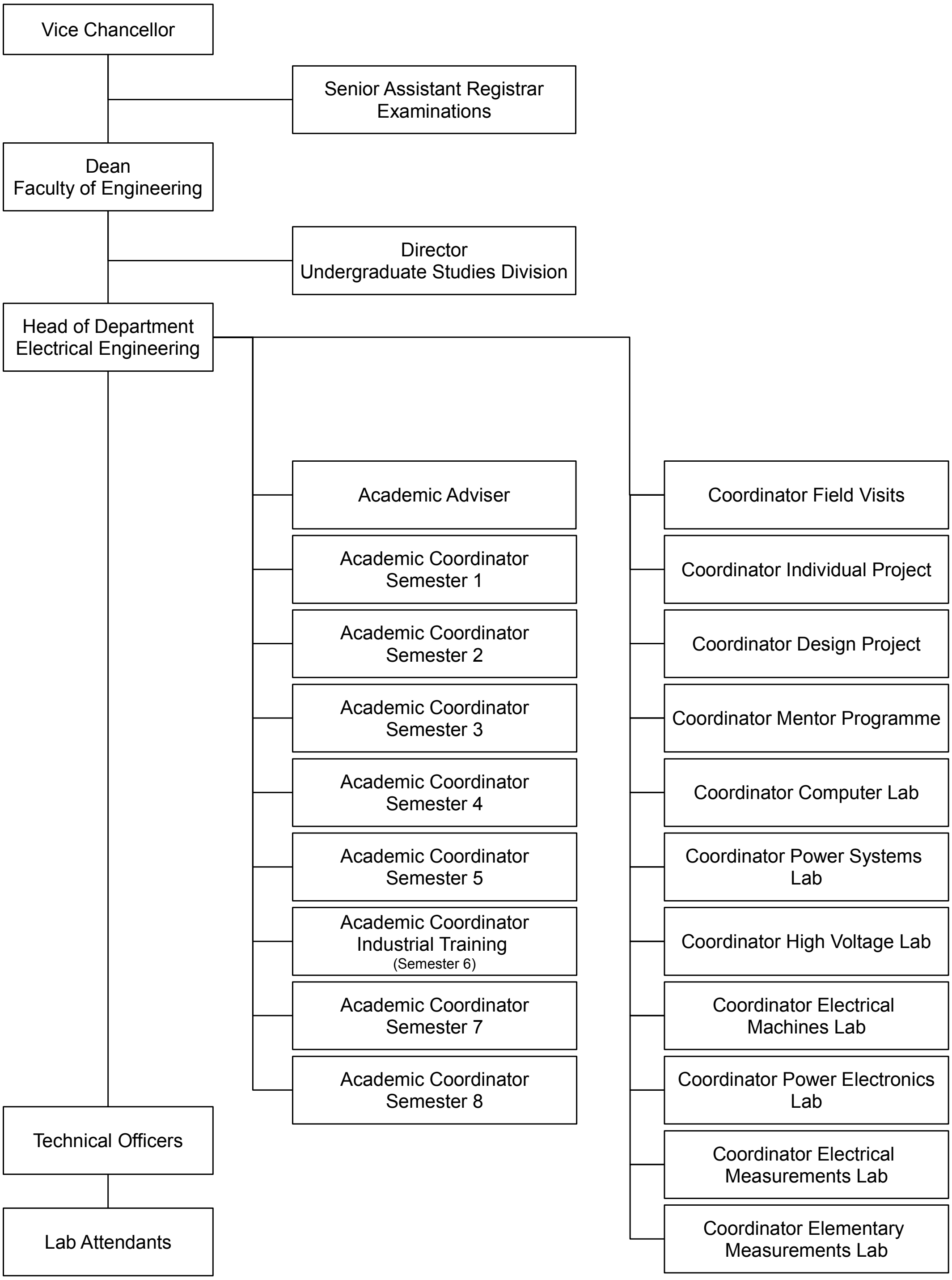
The department has eight well equipped laboratories namely, power systems laboratory, electrical machines laboratory, power electronics laboratory, high voltage laboratory, electrical construction laboratory, computer laboratory, measurement laboratory, and elementary measurement laboratory. Two other state of the art laboratories in artificial lighting and industrial automation are planned to be added in the near future. You will have ample opportunities to experience the modern practice of electrical engineering in these laboratories.

Electrical Engineering Society is the social wing of the department. All students register as members of this society and participate actively in organizing various social functions. It helps immensely to sustain the friendly atmosphere of staff and students in the department.

I am sure you will have a very interesting time ahead. I, together with other members of the staff join hands to wish you a very happy stay in this department.

Dr. J. P. Karunadasa
Head, Department of Electrical Engineering

Organisation Chart



Organisation chart for the undergraduate Programme in Electrical Engineering

Department of Electrical Engineering

Organisation of the Department

The Head of Department is the principal executive officer responsible for both academic and non academic administration of the Department. The other senior academic staff members help the Head of Department conduct the day to day administration in the capacity of coordinators for semesters, projects, field visits and training etc. In addition, the Department has two permanent academic advisers to help students with their academic matters. The laboratories are overseen by respective technical officers with the help of other technical staff attached to each laboratory. An academic staff member is also assigned to every laboratory to be in overall charge of the administrative duties.

The Electrical Department presently conducts one undergraduate degree programme of B.Sc. Engineering Honours in Electrical Engineering, and three part-time postgraduate courses – M.Sc. in Electrical Engineering, M.Sc. in Electrical Installations and M.Sc. in Industrial Automation (in collaboration with Mechanical Engineering Department). The Electrical Department also collaborates with Civil and Mechanical Engineering Departments to offer M.Sc. course in Building Services. Postgraduate degree courses cater to the needs of the students who want to specialise in industry oriented specialisations in electrical engineering beyond their first degree. Further, the Department offers postgraduate research programmes up to the level of Ph.D. degree.

Academic Coordinators and Advisers

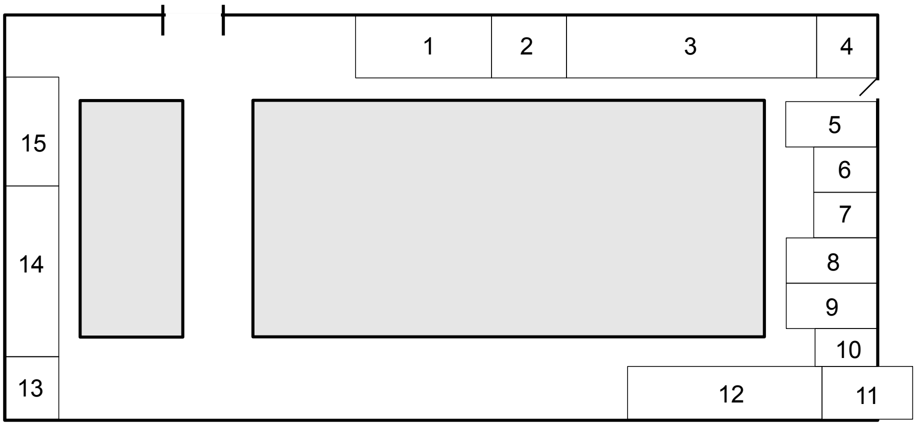
Presently the undergraduate degree program is coordinated by following senior academic members under the guidance of Head of the Department.

Function	Coordinator
Academic Adviser	Prof. J. Rohan Lucas
Academic Coordinator – Semester 1	Ms L.P.J.P. Premaratne
Academic Coordinator – Term A	Prof. J. Rohan Lucas
Academic Coordinator – Semester 2	Dr. Nalin Wickramarachchi
Academic Coordinator – Semester 3	Ms. Buddhi Wanniarachchi
Academic Coordinator – Semester 4	Dr. Asanka Rodrigo
Academic Coordinator – Semester 5	Dr. D. P. Chandima
Coordinator Industrial Training – Semester 6	Dr. Satish S. Namasivayam
Academic Coordinator – Semester 7	Dr. Udayange Hemapala
Academic Coordinator – Semester 8	Dr. Buddhika Jayasekara
Field Visits	Eng. WDAS Wijayapala
Design Project	Dr. Harsha S. Abeykoon
Individual Project	Dr. Asanka Rodrigo
Mentoring Programme	Prof. Lanka Udawatta

Function	Coordinator
Computer Laboratory	Prof. Lanka Udawatta
Power Systems Laboratory	Dr. Udayange Hemapala
High Voltage Laboratory	Eng. WDAS Wijayapala
Electrical Machines Laboratory	Dr. D. P. Chandima
Power Electronics Laboratory	Dr. D. P. Chandima
Electrical Measurements Laboratory	Dr. Harsha S. Abeykoon
Elementary Measurements Laboratory	Dr. Harsha S. Abeykoon

Location and Floor-plan

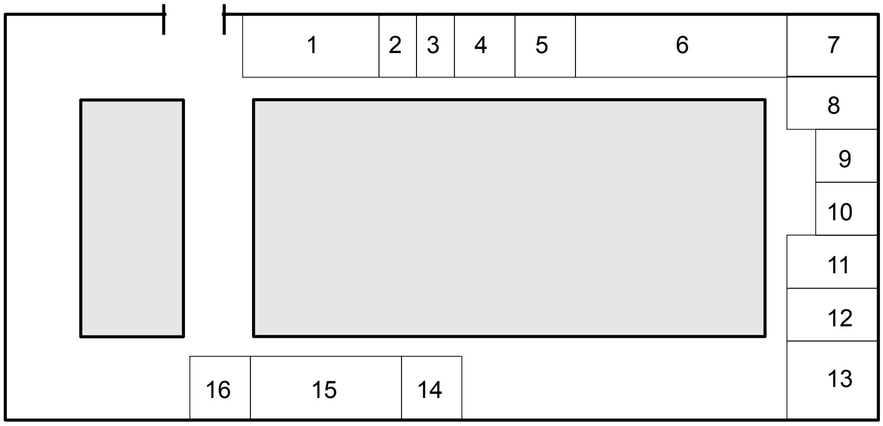
The Department and its divisions are housed at Ground Level, 1st Floor and 2nd Floor of the Dr. L.H. Sumanadasa building. The Office room together with the room of Head of Department are located on the 1st Floor. Location of rest of the Departmental facilities including laboratories and staff rooms are illustrated in the following floor plans.



Ground Level

Key	Room (Ground Level, Sumanadasa Building)
1	Computer Laboratory
2	Staff room – Dr. Harsha S. Abeykoon, Dr. Asanka Rodrigo
3	Power Systems Laboratory
4	High Voltage Laboratory
5	Staff room – Prof. Lanka Udawatta
6	Staff room – Dr. D. P. Chandima
7	Staff room – Dr. Udayanga Hemapala
8	Staff room – Dr. Nalin Wickramarachchi

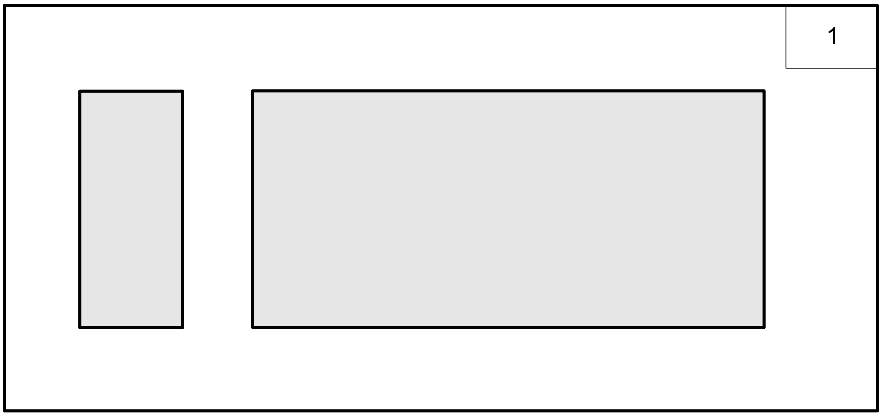
Key	Room (Ground Level, Sumanadasa Building)
9	Staff room – Eng. WDAS Wijayapala
10	Department workshop
11	Undergraduate project Laboratory
12	Electrical Machines Laboratory
13	Postgraduate research Laboratory
14	Common staff rooms
15	Power Electronics Laboratory



First Floor

Key	Room (First Floor, Sumanadasa Building)
1	Electrical Engineering seminar room
2	Senior staff common room
3	Electrical Engineering Board room
4	Head of the Department
5	Department office
6	Electrical Measurements Laboratory
7	High Voltage Laboratory (Control Room)
8	Staff room – Prof. J. Rohan Lucas
9	Staff room – Prof. Sisil Kumarawadu
10	Staff room – Dr. Satish S. Namasivayam
11	Staff room – Prof. H. Y. R. Perera
12	Staff room – Dr. J. P. Karunadasa

Key	Room (First Floor, Sumanadasa Building)
13	Staff room block – Dr. Buddhika Jayasekara
14	Elementary Measurements Laboratory
15	Electrical Installation Laboratory
16	Staff room – Ms. Buddhi Wanniarachchi



Second Floor

Key	Room (Second Floor, Sumanadasa Building)
1	Electrical Final Year room

Contact Information

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Facilities of the Department

The Electrical Department is committed to providing laboratory facilities, equipment and computing infrastructure necessary for creating a conducive learning environment for effective delivery of its undergraduate programme. We make every reasonable effort to keep these facilities up to date and relevant to the teaching modules, despite the practical constraints and limitations inherent to an educational institute financed through public funding.

Electrical Measurements Laboratory

The Electrical Measurements Laboratory has been set up mainly to teach the practical aspects of the basics of electrical theory and measurements to undergraduate and lower level courses. The associated subjects for lab classes are Theory of Electricity and Electrical Measurements. The Electrical Measurements Laboratory is also used in carrying out research, consultancy and testing work.
Technical Officer - Mr. M.W.D. Wasantha

Elementary Measurements Laboratory

The Electrical Measurements Laboratory has been set up mainly to conduct practicals to first year undergraduates. The associated subject for lab classes is Electrical Engineering in Semester 1 of the BSc course. The Electrical Measurements Laboratory is also used in carrying out research, consultancy and testing work.
Technical Officer - Mrs. H.A.P. De Silva

Power Systems Laboratory

The Electrical Power Systems Laboratory has been set up mainly to teach the practical aspects of Power Systems Engineering to students at all levels. At present it conducts parts of the following laboratory classes. Introduction to Power Systems, Generation & transmission, Power System Protection, Power Distribution & Utilization, Power System Analysis. The Power Systems Laboratory is also used in carrying out research, consultancy and testing work.
Technical Officer - Mr. H.D.A. Chandana

Electrical Machines Laboratory

The Electrical Machines Laboratory has been set up mainly to teach the practical aspects of Machines to students at all levels. At present it conducts laboratory classes for the following subjects: Introduction to Electrical Machines, Induction machines and Electrical Drives & Applications. The Electrical Machines Laboratory is also used in carrying out research, consultancy and testing work.
Technical Officer - Mr. J. D. Leelasiri

Power Electronics Laboratory

Power Electronics laboratory has been set up to facilitate students to learn Power Electronics and its applications. The Power Electronics Laboratory deals with the Power Electronics aspects of the Electrical Machines Laboratory and caters to the final year undergraduate and postgraduate students only. At present it conducts laboratory classes for the following subjects: Power Electronics and its Applications, Electrical Drives &

Applications. The Power Electronics Laboratory is also used in carrying out research, consultancy and testing work.
Technical Officer - Mr. S.R.P. Silva

High Voltage Laboratory

The High Voltage Laboratory has been set up to cater to the final year undergraduate and postgraduate students only. At present it undertakes the laboratory components of the following subjects, Insulation Co-ordination and High voltage breakdown & Testing. The High Voltage Laboratory is also extensively used in carrying out research, consultancy and testing work.
Technical Officer - Mr. H.D.A. Chandana

Electrical Installation Laboratory

This laboratory, originally named as Wiring Diagrams & Electrical Construction, has been set up mainly to teach the practical aspects of Electrical Installation Engineering to students at all levels. At present it conducts parts of the following laboratory classes for the students, Electrical Engineering of all fields and Electrical Installations.
Technical Officer - Mr. K.D.A.A. Somasiri

Computer Systems Laboratory

The Departmental computer services consist of over twenty five personal computers for students and one UNIX server. The Local Area Network links most of the laboratories and staff rooms and has internet facility through the campus/LEARN network. The Computer Systems Laboratory is used by the undergraduate students and the postgraduate students for their assignments and project work, and for internet searching, email and word-processing. Associated subjects for the lab classes are Control theory and Computer Aided Design & Simulation.
Network Administrator – Mr. J. Wickramaratna

Working hours and access times

Department of Electrical Engineering is usually open for academic work from 8.30 a.m. to 4.30 p.m. on weekdays except public holidays.

All laboratories in the Department of Electrical Engineering are available for students strictly during the scheduled practical sessions and students should not use any equipment without the permission of the lecturer in charge or under the guidance of a Laboratory Instructor.

The Computer laboratory is open from 7.30 a.m. to 8.00 p.m. on weekdays and closed on weekends. At present all other facilities are available during working hours only.

Undergraduate Programme of Study

The Electrical Department regularly revises its curriculum and syllabi in keeping with the standards of teaching excellence followed by the University of Moratuwa. Thus the contents of its programme is kept up to date and made to serve the needs of the country and students in preparing them for a future career in Electrical Engineering. The latest such revision came into effect from 2009 and the details of which is presented in this handbook.

The newest revision signifies a major overhaul of the Electrical Engineering curriculum and syllabi. New subject modules have been added, some previous modules have been terminated or distributed to other modules and contents of almost all modules have seen major modifications. In parallel, the performance criterion has also undergone significant changes. As a result, you will find that your course of study has little relevance to what your seniors had followed before you. So please be cautious and do not hesitate to contact the academic advisers in case you have any queries regarding the curriculum or selection of electives/options.

An Overview

The programme of study leading to the award of the BSc Engineering Honours Degree consists of eight academic semesters – designated as Semester 1 to Semester 8, and three terms – designated as Term A to Term C, offered over four academic years. Normal duration of academic teaching in a semester is 15 weeks, that in a term is 10 to 12 weeks and duration of industrial placement is 24 weeks. The balance period is taken up by examinations and vacations. A six week pre-academic term prior to the commencement of the B.Sc. degree course bridges the gap between high school education and the academic environment in a University, thus preparing students for a more effective learning experience.

Selection of fields of specialization will be made by the students at the end of Semester 1 which is common to all MPR intake. From Semester 2 onwards the students come under the administration of the respective Department.

The undergraduate programme in Electrical Engineering specialisation starting with Semester 2 will introduce you to the fundamentals of Electrical Engineering theory in Semester 2 and gradually from Semester 3 through 5 you will be learning how to apply the theory to core areas of Electrical Engineering such as Power Systems, Electrical Machines and high Voltage. Further, you will be acquiring the principles of Electronics, Telecommunications and Computer Science during the same period .

Modules are categorized into four levels of academic progression from 1 to 4 which represent your current standing in the process of completing the 150 credits required for the degree of B.Sc. in Electrical Engineering. Note that some modules have pre-requisites from a lower level of academic progression while some others have co-requisites from the same level. Modules are either compulsory—which must be taken, elective—a minimum combination of which must be taken as specified in the curriculum, or optional—which may or may not be taken as per your preference.

Credits and Academic Load

Each module is assigned a credit value which represents the expected workload when taking the particular module. For a typical module extending over one semester, one credit is given for each hour of academic lectures per week or three hours of assignments such as tutorials, laboratory work, field work or design work per week. The industrial placement of 24 week duration is assigned six credits while Design Project at Semesters 7 and 8 is counted as 10 credits equally distributed over each semester.

The recommended credit load for each semester or term is called the *norm* and it is specified in the approved curriculum. Irrespective of the norm, maximum workload a student could register for a semester is 26 credits. A student must register for a minimum of 12 credits in a semester in order to consider him or her as a full-time student.

Registration for Modules and Attendance

You will be using the Faculty online registration system LearnOrg at the beginning of each semester to register for modules in that semester or term. You are required to consult and obtain the consent of the respective Academic Advisor prior to applying for registration. The Academic Advisor's consent is also needed for adding/dropping modules after registration; obtaining leave from academic activities and changing academic load. The add/drop period is limited to two weeks at the commencement of the semester.

Once registered for a module, you are required to attend all the lectures, laboratory classes, tutorials, continuous assessments etc. that are part of the the module. A minimum of 80% of attendance for lecture classes are necessary in order to be eligible to sit for the corresponding semester-end examination. The laboratory classes, tutorials, continuous assessments etc. will not be re-scheduled under any circumstance and if absent you will earn no marks for the corresponding components.

Evaluation of Performance

Your performance in each module will be evaluated by adding the marks for continuous assessment (CA) components and marks for end-of-semester written examination (WE). The ratio of marks allocated for CA components and written examination may vary with the module, however 30% for CA and 70% for WE would be the norm for most of the modules in Electrical Engineering. Candidates should obtain at least 35% of allocated marks for each of CA and WE to pass a module.

Grades based on the Grade Point system indicate the academic performance of students in each module he/she has registered.

Benchmark %	Grade	Grade Point	Description
85 and above	A+	4.2	
75 to 84	A	4.0	Excellent
70 to 74	A –	3.7	
65 to 69	B+	3.3	
60 to 64	B	3.0	Good
55 to 59	B –	2.7	

Benchmark %	Grade	Grade Point	Description
50 to 54	C+	2.3	
45 to 49	C	2.0	Pass
40 to 44	C –	1.5	Weak Pass
35 to 39	D	1.0	Conditional Pass
34 and below	I	0.0	Incomplete
	F	0.0	Fail
	N	–	Academic Concession
	W	–	Withdrawn

Grade D or above is required to earn credit for a module. A student failing one of either CA or WE components receives an incomplete grade I, and can sit for a repeat examination in the failed component only. If a student fails both CA and WE components he or she receives an F grade, and must repeat both components in order to earn the respective credits.

The grades F, I, D or C– can be improved up to a C grade via a repeat attempt. The maximum grade awarded for repeating a module will be a C and it will be used for calculating Semester Grade Point Average (SGPA).

Grade N signifies Academic Concession granted with the approval of the Faculty in the event a student is unable to sit for the WE due to illness or other compelling reason accepted by the Senate. Grade W indicates a module withdrawn by the student with the approval of the Faculty and the Senate. The grade is not counted in the calculation of the SGPA.

Note that the transcript which carries your academic performance will show the grade achieved by you in each of the module you have registered. The grade at the first attempt or the improved grade earned at a subsequent attempt will be recorded in the transcript.

Academic Progression

If a student obtains an SGPA between 1.99 and 1.50, then he/she is placed on academic warning. If the earned SGPA is less than 1.50, the student is put on academic probation. A student on Academic Warning or Academic Probation will not be allowed to carry any additional academic load.

A student who falls into one of the following categories due to failure to upgrade the SGPA will not be permitted to register for a new module until the SGPA improves as required.

i. SGPA < 1.50 in any two semesters.
ii. SGPA < 1.50 in any semester, and 1.5 ≤ SGPA < 2.00 in any two semesters.
iii. 1.5 ≤ SGPA < 2.00 in any four semesters.

Academic Concession

A student who has missed a WE or any other course requirements because of illness or other compelling reason may appeal with supporting documents to the Dean for an Academic Concession for consideration of the Senate. In case of a written examination, the student should submit an application with supporting documents within the time period specified under the clause on Absence from Examination of By-Law No. 15: Conduct of Examination from the date of an 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 or term.

The applications forms for consideration of absence from end of semester examinations on medical ground are available with the Senior Assistant Registrar (SAR), Examination Division. Note that you have to inform the SAR, Examination via a Telegram/Registered Letter as soon as possible after your absence from an examination. Also you need to furnish medical certificates from University Medical Officer or a qualified medical officer together with your application form.

The Senate of the University takes the final decision regarding applications for academic concession.

Dean's List

A student who obtains a Semester Grade Point Average of 3.80 or greater in any semester (except during terms) will be recommended by the Board of Examiners to be included in the Dean's List and such a placement will also be noted on the student's transcript. In addition to the Semester GPA participation in extracurricular activities also be given consideration.

Graduation

A candidate should satisfy a total of 150 credits, including a minimum of 135 GPA credits and a minimum of 12 non-GPA credits from among the modules specified for Electrical Engineering specialization, in order to be admitted to the BSc Engineering Honours in Electrical Engineering degree.

The curriculum approved for the Electrical Engineering stream is given in the Table on Page 25 onwards. The curriculum indicates, compulsory (C), elective (E) and optional (O) modules along with their respective credit loading, either GPA or Non-GPA, recommended for each semester of the undergraduate course. Note that the approved curriculum includes 4 GPA credits from two compulsory non-technical modules offered during Term A and Term C of the programme.

A minimum Overall GPA of 2.00 is necessary for graduation.

Award of Classes

Awarding of Classes is determined at the completion of all the graduation requirements by a candidate. A candidate become eligible for award of a Class only if he/she completes the graduation requirements within five academic years. The Overall GPA of a candidate will be used for awarding of Classes as in the Table below.

Overall GPA	Academic Standing
3.70 or above	First Class
3.30 – 3.69	Second Class Upper Division
3.00 – 3.29	Second Class Lower Division
2.00 – 2.99	Pass

Department Awards

The Department of Electrical Engineering presents two awards every year to the graduands on the basis of their overall academic performance. The details of which are as follows.

i. The Gold Medal is awarded to the Electrical Engineering graduand who has obtained the highest Class Average of not less than 3.80 GPA at the B.Sc. Engineering degree Final Examination, donated by Professors Samarajeewa Karunaratne, Rohan Lucas, Priyantha Wijayatunga and Ranjit Perera. This is awarded at the General Convocation.

ii. Professor Ted Parish Award is awarded to the Electrical Engineering graduand who has obtained the highest Class Average of not less than 3.70 GPA at the B.Sc. Engineering degree Final Examination, donated by Professor Ted Parish. Awarded only in years when no one qualifies for the Gold Medal and is awarded at the General Convocation.

iii. EESoc award for the best Electrical Engineering undergraduate project is awarded to the group of students whose undergraduate project is selected by the Department as the best project in the year. This is donated by the Electrical Engineering Society (EESoc) and awarded at the Academic Award Ceremony of the University of Moratuwa.

Curriculum – B.Sc. Engineering Honours in Electrical Engineering

Code	Module Name	Category	Hours per week		Credits		Norm†		
			Lectures	Lab/ CA‡	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				
EE2092	Theory of Electricity	C	2	-	2.0				
EN1802	Basic Electronics	C	2	3/4	2.0				
EN1052	Introduction to Telecommunications	C	2	–	2.0				
CS2812	Visual Programing	C	2	-	2.0				
CS2842	Computer systems	C	2	-	2.0				
ME1802	Introduction to Manufacturing Engineering	C	2	3/2	2.5				
EE1092	Laboratory Practice II	C	-	3/1	1.0		16.5		16.5

Code	Module Name	Category	Hours per week		Credits		Norm†		
			Lectures	Lab/ CA‡	GPA	NGPA	GPA	NGPA	Total
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				
EN2022	Digital Electronics	C	2	3/2	2.5				
ME2012	Mechanics of Materials I	C	1.5	3/2	2.0				
CE1822	Aspects of Civil Engineering	C	2	-	2.0				
EE2292	Laboratory Practice III	C	-	3/1	1.0		20.0		
	Optional From CSE/MECH/CIVIL	O	2		2.0				20.0
Semester 4									
MA2032	Linear Algebra	C	2	-	2.0				
MA2042	Discrete Mathematics	C	2	-	2.0				
EE2132	Electromagnetic Field Theory	C	2	-	2.0				
EE2042	Electrical Measurements & Instrumentation	C	2	-	2.0				
EE2052	Control Systems I	C	2	1/1	2.0				
EE3072	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				
ME2842	Basic Thermal Sciences and Applications	C	2.5	3/2	3.0				
EE3202	Individual Project	C	2	-	2.0		22.0		22.0

Code	Module Name	Category	Hours per week		Credits		Norm†		
			Lectures	Lab/ CA‡	GPA	NGPA	GPA	NGPA	Total
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		
EE3902	Communication and Presentation Skills	C	1.5	-		1.5		1.5	
	Optional from CSE/ENTC/MECH	O	2	-	2.0				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				
MN4022	Engineering Economics	E*	2	-	2.0				
MN4042	Technology Management								
EE4012	Automation and Control Technologies	C	2	-	2.0				
EE4072	Computer Aided Design & Simulation	C	1.5	3/2	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				

Code	Module Name	Category	Hours per week		Credits		Norm†		
			Lectures	Lab/ CA‡	GPA	NGPA	GPA	NGPA	Total
EE4092	Laboratory Practice VII	C	-	3/1	1.0		21.0		
EE4902	Field Visit		-	2/2		1.0		1.0	
	Optional from CSE/ENTC/MECH	O	2	-	2.0				22.0
Term C									
DE30x2	Non-Technical Option II	C	2	4/1			2.0		2.0
Semester 8									
MN4072 MN4092 MN4122	Small Business Managemt & Entrepreneurship Management Skills Development Human Resource Management & Industrial Relations	E*	2	-	2.0				
EE4022	High Voltage Engineering II	C	2	-	2.0				
EE4062	Power Electronics and Applications II	C	2	-	2.0				
EE4202	Design Project (contd...)	C	-	-	5.0				
EE4192	Laboratory Practice VIII	C	-	3/1	1.0		12.0		12.0
EE4082	Robotics and Mechatronics	O	2	-	2.0				
EE4702	Renewable Energy and the Environment	O	2	-	2.0				
EE4712	Real-time Computer Systems	O	2	-	2.0				
MA4022	Operational Research	O	2	-	2.0				
MA4032	Time Series & Stochastic Process	O	2	-	2.0		8.0		8.0
	Grand Total						**137.5**	**12.5**	**150**

C/E/O Compulsory/Elective/Optional

*E One of these 5 electives must be taken in either semester 7 or 8.

†Norm Recommended credit load for each semester/term. The actual load may vary depending on the student preference. However, the maximum load a student may register in a semester is limited to 26 credits.

‡Lab/CA *n/m* signifies *n*-hours repeated every *m*-weeks of Laboratory or Continuous Assessment. May also comprise of assignments and/or tutorials.

Special Modules
The curriculum of Electrical Engineering consists of the following special modules which have been designed to enhance the hands-on experience of undergraduates in dealing with engineering projects, team skills and exposure to electrical engineering industry in Sri Lanka.

Engineering Design and Skill Development (Term A)
These two modules help develop, among other skills, teamwork, innovation, choice of materials, survey skills, pricing and marketing skills and manufacture through a simple engineering design. The creativity in engineering design process is brought out by allowing students to participate in small design groups. Each group identifies a significant engineering problem, proposes a solution and then proceeds to demonstrate feasibility of their solution through construction of a prototype. Students will gain knowledge of basic engineering tools such as workshop, drawing, AutoCAD, PSpice etc. through the implementation process of the prototype.

Laboratory Practice (every semester except semester 6)
Each semester consists of one compulsory module of Laboratory Practice where you will be performing the laboratory experimentation relevant to the electrical engineering subjects of that semester. While there is no end-of-semester written examination, the final grades will be calculated by totalling the individual marks earned by you for each practical session. Note that the marks earned with respect to different experiments will not be considered as part of continuous assessment marks of the relevant subject modules in that semester.

Non-Technical Option (Term A and C)
All students in Electrical Engineering are supposed to offer 4 GPA credits of Non-Technical subjects, generally two modules each in Term A and C. The undergraduate division of the Faculty of engineering arranges a large number of modules in the general areas of art, performing arts, social sciences, religion, languages and general interests. Since the registration is allowed only for limited numbers, students are advised to select their preferences with diversity and advance planing.

Individual Project (Semester 4)
In this module students will do research and design of an engineering product or system individually and independently complying with technical, financial, environmental and social requirements. The assessment is done through a presentation of results and a project report.

Industrial Training (Semester 6 and Term B)
The undergraduate programme includes 24 weeks of continuous Industrial Training placement. The training placements are arranged by the Department so that every student gets an opportunity of training in both the Ceylon Electricity Board and one other industry related to Electrical Engineering. The Industrial Training module is assessed at the end via a viva voce and a written report. The module is mandatory and worth 6 non-GPA credits.

Industrial Training is meant to provide hands-on technical training related to the industry. Both public and private sector organizations in Electrical generation, transmission, utilization and IT, provide industrial training to Electrical undergraduates. Some such partners who provide training opportunities in addition to Ceylon Electricity Board are Lanka Electricity Company Limited, Lanka Transformers Ltd., Airport & Aviation Authority, Ports Authority, Nikini Automation Pvt. Ltd., Ace Power Ltd, Lakdhanavi etc.

During this period, the undergraduates are supposed to learn how the theoretical principles learnt in the class room could be applied practically and demonstrate the skills, knowledge and attitudes needed for an effective start of the engineering profession. The students will work with different categories of people in an industrial environment adopting to appropriate technical, environmental, economic and social constraints. Furthermore they will acquire knowledge of organizational, financial and human resource management.

Upon completion of the module, students submits an individual report detailing the experience gained during training and faces an interview for assessment and feedback. Evaluation of the training report is carried out by the Industrial Training Division of the Faculty of Engineering. The staff of the Department contributes to the evaluation process by conducting visits to training places to observe the performance of the trainees and also by being a member of the interview panel.

Field Visits (Semester 7)
The curriculum also contains a Field Visit module which is directly related to the industrial exposure of students in addition to the compulsory module on Industrial Training. The aim is to provide an opportunity for the students to observe the field implementation of specific electrical engineering projects and processes around the country. Due to the limited time of a visit and the large number of students taking part, the opportunity for hands-on experience is limited. However, you get the opportunity to observe the most recent and state of the art power projects being implemented in Sri Lanka.

Field visit are generally 1-2 days in duration and the university provides transport free of charge while all other expenses need to be borne by the students.

After the visit, each student is expected to prepare a technical report on the place she/he visited. The report will be evaluated by the module coordinator and a grade will be awarded. The field visits conducted recently include Ace Power Pvt. Ltd. (100 MW Diesel power plant, Embilipitiya), Upper Kothmale Hydro Power Project (150 MW run of the river hydropower plant under construction and Wind power Plant, Puttalam.

Design Project (Semesters 7 & 8)
Each student is required to acquire ten (10) credits from the compulsory Design Project, normally undertaken as a joint project with four students in each group.

The group is expected to function as a coherent product development team, and the members are encouraged to plan and implement their own management structure within the team. The different functions are rotated, so that each student has an opportunity to both acquire and demonstrate varied skills required for the overall success of the project. These include design, creativity, problem solving, innovation and management. Other skills such as those of language, communication and presentation (both written and verbal), public relations etc. are also important for the successful completion of the Design Project.

Design Project is evaluated continuously throughout the two semesters via progress review presentations. At the end of the module, the final evaluation is done through viva-voce and demonstration of your project achievements/implementations.

Detailed Syllabi – Electrical Engineering

Semester 1

Module Code	**MA1012**	Module Title	**Mathematics**			
Credits	**3.0**	Hours/Week	Lectures	**3.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**1/1**		

Learning Outcomes
After completing this module, the students should be able to demonstrate the understanding of
1. the concept of Discrete Structures in Mathematics such as Logic, and Set Theory.
2. the concept of Algebraic Structures in Mathematics such as Real Numbers, Complex Numbers, Vectors and Matrices.
3. the basic concepts in Analysis such as Limits, Differentiation and Integration.
4. modern concepts of statistical thinking and its foundations on probability.

Outline Syllabus
1. Logic and Set Theory
   Propositions, Truth tables, Quantifiers, Techniques of Proof: Direct, Contradiction, Induction; Sets, Cardinality, Power Set, Cartesian Product, Ordered Pairs, Relations, Functions, Inverse Relations and Functions, Composite Relations and Functions.
2. Real Analysis
   Real Number System, Real Intervals, Supremum and Infemum, Completeness Axiom, Powers on Numbers, Basic Functions: Polynomial, Exponential, Trigonometric, Hyperbolic; Their Inverses, Limit of a Function, Extended Real Number System, Continuity, Differentiability, Derivative and Higher Derivatives, Maxima and Minima, Rolle's Theorem, Mean Value Theorem, L' Hospital's Rule, Sequences, Cauchy Sequences, Infinite Series, Convergence of Series: Ratio Test, Comparisons Test, Limit Comparison Test, Maclaurine's Integral Test; Harmonic Series, Infinite Products, Power Series, Taylor's Series, Integration of Continuous Functions, Definite and Indefinite Integrals.
3. Complex Numbers, Vectors, and Matrices
   Algebra of Complex Numbers, De Moriver's Theorem, Argand Diagram, Vector Algebra, Scalar Triple Product, Vector Triple Product, Line and Plane, Matrix Algebra, Echelon Forms, Rank, Determinants, Eigen Values, Spectral Radius, Matrix Norms: Maximum row sum, Column sum; System of Linear Equations, Existence of solutions.
4. Basic Probability
   Pigeon-Hall Principle, Permutations and Combinations, Basic Laws and Elementary Theorems in Probability, Conditional Probability, Baye's Theorem, Integer Equations, Discrete and Continuous Random Variables. Probability and Cumulative Distribution functions, Joint Distribution Function, Integer Equations, Generating Functions.

Module Code	**CS1032**	Module Title	**Programming Fundamentals**			
Credits	**3.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**3/1**		

Learning Outcomes
After completing this module, the students should be able to
1. device algorithms to solve given problems.
2. develop programs from algorithms using main features of a high level programming language such as C.

3. use an Integrated Development Environment.

Outline Syllabus

1. Structure of a computer system
2. Algorithms
3. Programming in C
   - Data Types
   - Control Structures and iteration
   - Modularity and functions
   - Input, output and file handling
   - Structures and arrays
   - Efficiency and performance
   - Problem solving with programs
4. User-interface design

Module Code	**ME1032**	Module Title	**Mechanics**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**3/4**		

Learning Outcomes

After completing this module, the students should be able to demonstrate

1. the ability to calculate rigid body forces and motions
2. the ability to perform simple mechanics experiments
3. the understanding of the basic concepts of dynamics
4. the ability to model and solve basic systems in dynamics.

Outline Syllabus

1. Properties of plane areas.
2. Internal forces and principle of superposition.
3. Determination of forces in assemblies of rigid bodies.
4. Kinematics of particles and rigid bodies, 2D link mechanisms.
5. Kinetics of particles and rigid bodies, work and energy methods.
6. Mechanical vibrations (Free vibrations of single degree of freedom systems).

Module Code	**MT1022**	Module Title	**Properties of Materials**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**3/4**		

Learning Outcomes

After completing this module, the students should be able to

1. recognize the structure of metals, polymers and ceramics.
2. identify the relationships between the structure of materials and their properties.
3. assess the properties of engineering materials.

Outline Syllabus

1. Structure of atoms, atomic theories, atomic bonding in materials.
2. Crystal structures and defects.
3. Structure-property relationships.
4. Mechanical properties of materials.

5. Electrical properties of materials.
6. Chemical properties of materials.
7. Radioactivity and nuclear properties.

Module Code	CE1022	Module Title	Fluid Mechanics			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**3/4**		

Learning Outcomes
After completing this module, the students should be able to demonstrate the ability to
1. calculate static fluid forces & solve problems in Fluid Statics
2. analyse problems in fluid flow by continuity, energy & momentum considerations

Outline Syllabus
1. Properties of Fluids
2. Hydrostatic Pressure
3. Hydrostatic Thrust on Submerged Surfaces
4. Buoyancy
5. Introduction to Fluids in Motion
6. Continuity Equation and its Applications
7. Bernoulli's Equation and its Applications

Module Code	EE1012	Title	Electrical Engineering			
Credits	**2.0**	Hours/Week	Lectures	**1.5**	Pre-requisites	**None**
GPA/NGPA	**GPA**		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.

Module Code	**EL1012**	Module Title	**Language Skills Enhancement I**			
Credits	**1.0**	Hours/Week	Lectures	**–**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**3/1**		

Learning Outcomes

After completing this module, the students should be able to

1. read and comprehend subject related texts.
2. demonstrate the ability to understand and write the gist of a subject related text.
3. demonstrate the ability to understand and express the content of a text in his/her own words.
4. illustrate or develop an idea in writing coherently and logically.
5. demonstrate the ability to participate in a subject related discussion.

Outline Syllabus

1. Subject related texts.
2. Précis.
3. Paraphrase.
4. Writing paragraphs.
5. Group discussions.

Term A1 and A2

Module Code	**EL1022**	Module Title	**Language Skills Enhancement II**			
Credits	**1.0**	Hours/Week	Lectures	**–**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**6/1**		

Learning Outcomes
After completing this module, the students will be able to

1. contribute to a group project through discussion and other related work.
2. make a short presentation on a subject related topic.
3. describe a simple process.

Outline Syllabus

1. Group projects.
2. Training in presentation skills.
3. Reinforcing writing skills.

Module Code	**MN1012**	Module Title	**Engineering in Context**			
Credits	**1.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**NGPA**		Lab/Assignments	**–**		

Learning Outcomes
After completing this module, the students will be able to

1. recognize the scientific and social contexts in engineering profession.
2. identify the basic ingredients of professionalism in engineering.
3. explain the importance of economic, risk and safety issues for the engineering decisions.
4. describe the basic professional skills, ethics and concepts required for an engineer in industrial society.

Outline Syllabus

1. What is engineering and its relevance to society. Historical development of engineering and Sri Lankan engineering heritage (old and recent).
2. Economic, risk and safety issues in engineering. Roles and responsibilities of a professional engineer in society and industry.
3. Interaction of engineering with natural and built environment; Engineering solutions for environmental problems.
4. Sustainable engineering design, learning from failures.
5. Skills of engineer in industrial environment (management, teamwork, communication).

Module Code	**EE1952**	Module Title	**Engineering Design**			
Credits	**1.5**	Hours/Week	Lectures	**2.0**	Pre-requisites	**Semester 1**
GPA/NGPA	**NGPA**		Lab/Assignments	**3/1**		

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. Group based design assignments The projects 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.

Module Code	**EE1962**	Module Title	**Skill Development**			
Credits	**1.5**	Hours/Week	Lectures	**1.0**	Pre-requisites	**Semester 1**
GPA/NGPA	**GPA**		Lab/Assignment	**6/1**		
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.						

Semester 2

<table>
<tr><td>Module Code</td><td>MA1022</td><td>Module Title</td><td colspan="4">Methods of Mathematics</td></tr>
<tr><td>Credits</td><td>3.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>3.0</td><td>Pre-requisites</td><td>MA1012</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Tutorial</td><td></td><td></td><td></td></tr>
<tr><td colspan="7">Learning Outcomes
1. Understand the basic concepts of Numerical Methods.
2. Able to solve Ordinary Differential Equations.
3. Acquire the concepts of Multivariate Function and Calculus.
4. Acquire the concepts of Distributions for Statistical Applications.</td></tr>
<tr><td colspan="7">Outline Syllabus
1. Numerical Methods
Approximations by Taylor Series, Numerical Solution of System of Linear Equations: Non Iterative Methods: Gauss Elimination, LU Factorization; Iterative Methods: Gauss-Seidel and Jacobi Methods; Solution of Non-linear Equations: Bisection, Simple Iterative, Newton-Rapson; Polynomial Approximation of Functions: Lagrange Polynomials, Newton’s Divided Differences, Least Square Polynomial and Functions, Finite Differences, Interpolation and Extrapolation, Numerical Differentiation, Numerical Integration: Trapezoidal, Simpson’s Rules, Numerical Solution of Ordinary Differential Equations: Euler’s Method, Taylor Series Method.
2. Ordinary Differential Equations
Orthogonal Trajectories, Isoclines, First Order Ordinary Differential Equations; Variable Separable, Homogeneous, Linear and Exact; Reducible Forms, Second Order Ordinary Differential Equations, Reducible Forms.
3. Multivariate Calculus
Multivariable Functions, Partial Differentiation, Chain Rule, Change of Variables and Jacobians, Directional Derivatives, Maxima and Minima, Lagrange Multipliers, Taylor Series Expansion, Double Integral, Triple Integral, Geodesics, Vector Functions, Introduction to Vector Calculus.
4. Statistics
Discrete and Continuous Random Variables, Joint Distribution Functions, Introduction of Common Distributions and their application: Binomial, Poisson, Normal and Exponential. Measures of Central Tendency. Measures of Dispersion. Moments. Skewness. Kurtosis. Association between random variables: Pearson Correlation Coefficient, Rank Correlation Coefficient, Introduction of Bi-Varaite and Multivariate Distributions.</td></tr>
</table>

<table>
<tr><td>Module Code</td><td>EE2092</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>Co-requisite</td><td>EE1092</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>–</td><td></td><td></td></tr>
<tr><td colspan="7">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.</td></tr>
</table>

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
   Waveform parameters: rms, peak, rectified average etc., power, harmonics, Fourier analysis, Laplace transform, transient analysis using the Laplace transform.

Module Code	**EN1802**	Module Title	**Basic Electronics**			
Credits	**2.0**	Hours/Week	Lectures	**1.5**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**3/2**		

Learning Outcomes
At the end of the module the student will be able to

1. Describe basic principles of operation of semiconductor devices.
2. Use diodes and transistors in simple electronic circuits.
3. Use operational amplifiers in simple amplifier applications.
4. Use logic gates to design simple combinational logic circuits.

Outline Syllabus

1. Introduction
   Historical aspects, practical electronic systems, electronic industry, practical aspects of passive components, manufacturing electronic products, software tools.
2. Materials Used in Electronics
   Introduction to semiconductors and their basic properties, modern electronic materials.
3. Diodes, Diode Circuits and Applications
   Operation and characteristics of junction diode, zener diode, varactor diode and light emitting diode, rectification, clamping and limiting circuits, thyristors and controlled rectification.
4. Bipolar Junction Transistors (BJTs) and Circuits
   Operation and characteristics of BJT, use as a switch and as an amplifier, biasing schemes, amplifier configurations and parameters.
5. Field Effect Transistors (FETs) and Circuits
   Operation and characteristics of JFET, use as a switch and as an amplifier, comparison with BJTs.
6. Integrated Circuit Amplifiers
   The need for integration, operational amplifiers, inverting amplifier configuration of op amp, monolithic audio IC amplifiers.

7. Logic Gates and Circuits
   Logic gates and Boolean algebra, minimization of logic expressions, combinational logic circuits, introduction to sequential logic circuits, design of simple logic circuits.

Module Code	**EN1052**	Module Title	**Introduction to Telecommunications**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignment	–		

Learning Outcomes
At the end of the module the student will be able to
1. explain basic concepts related to communication systems.
2. differentiate between analog and digital communications principles.
3. describe basic aspects of a computer network.
4. differentiate between network topologies and types of networks.
5. discuss the operation of end user equipment in communications.

Outline Syllabus
1. Introduction to Telecommunication Systems
   Historical developments and current trends.
2. Elementary Concepts in Telecommunications
   Digital and analog signals, Types of communication channels, Bandwidth and filtering, The effect of bandwidth and noise on signals, The radio spectrum and wave propagation, Modulation.
3. Transmission
   Guided and unguided transmission, multiplexing, Transmission networks, Multiplexing hierarchies for high speed communication networks.
4. Access Networks
   PSTN, DSL, Wireless local loop, Mobile.
5. Switching and Signaling
   Hierarchical networks, teletraffic concepts.
6. Networking Principles
   Topologies, Types of networks, layered architecture, Internetworking, Security including Public Key Encryption.
7. Telecommunication Devices
   Telephone instrument, Radio receiver, TV receiver, Modems, cellular phones etc.

Module Code	**CS2812**	Module Title	**Visual Programming**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments			

Learning Outcomes
After completing this module, the students should be able to
1. Develop a working program for specified programming problem using a visual programming environment.

Outline Syllabus
1. Introduction to the concept of visual programming.
2. Introduction to visual programming environments.

3. Practice of visual programming using .NET Framework
    - Objects, Properties, Events and Methods
    - Variables, Data Types and Controls
    - Use of Forms and Controls to create User Interfaces
    - Program Control Flow
    - String and file manipulation
    - Arrays
    - Procedures and Functions
    - Exception Handling
    - Database Programming

Module Code	**CS2842**	Module Title	**Computer Systems**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignment	–		

Learning Outcomes
At the end of the course, a student will have an understanding of
1. the representations used for numbers and text, computer arithmetic,
2. the functions of the components of a CPU, how main memory is organised,
3. the architecture of the Pentium microprocessor, models for input/output.

Practical skills will be developed in particular, in developing assembly programs for the Pentium microprocessor.

Outline Syllabus
1. Introduction
   Relationship to other courses, levels of abstraction, instruction set level, hardware design level, role of the computer architect.
2. Data representation
   Binary numbers, arithmetic, octal, hex, base conversion, sign and magnitude, 1's complement and 2's complement, BCD, overflow, characters, ASCII/Unicode. Floating point numbers: conversion, normalisation, arithmetic operations, overflow/underflow representation errors, IEEE standard format, NANs, Infinity and denormalised values.
3. Memory Organisation
   Registers, RAM, disks; byte and word addressing; byte ordering, alignment, banks and interleaving.
4. CPU organisation and operation
   Components of a simple CPU, instructions, machine code, fetch-execute cycle, simple assembly programming.
5. Pentium architecture
   Programming model, registers, memory models, addressing modes, arrays, records, instructions, expressions, loops, procedures.
6. Input and output
   Device types and characteristics, controllers, ports, programmed I/O, interrupts, DMA, Pentium interrupt model, traps and exceptions, simple device drivers.
7. Operating Systems Introduction
   Objectives and functions, layers and views, user interfaces, as a resource manager, processes.
8. Process Management
   States and representation, creation and termination, processes and threads.

9. Process Scheduling
   Scheduling and dispatching, algorithms Concurrency and Synchronisation: mutual exclusion, deadlocks, starvation, locks, semaphores, monitors.
10. Memory Management
   Linking & loading, fixed and dynamic partitioning, fragmentation, virtual memory, paging, segmentation.

Module Code	**ME1802**	Module Title	**Introduction to Manufacturing Engineering**			
Credits	**2.5**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**3/2**		

Learning Outcomes
After completing this module, the students should be able to
1. explain the mechanics of machining processes, and their applications for different operations.
2. make a proper selection of manufacturing materials and tool materials for a given manufacturing process.
3. select the best machining operation(s), and plan out optimum machining process(es) for same.
4. use the principles of engineering metrology to assure quality of products.

Outline Syllabus
1. Overview of manufacturing engineering in the present context,
2. Introduction to selected manufacturing processes
   Casting, Fabrication, Hand tools and their importance.
3. Introduction to machining operations
   Classification of machining operations and machine tools, Mechanics of Machining, Mechanics of chip formation, types of chips, Built-up-Edge, Tool life, Surface finish, integrity, Cutting forces and power.
4. Engineering materials and tool materials
   Selection of work-piece materials and tools, correlating them to process and each other.
5. Detailed study of principal machining processes
   Machines and Tools used, Sawing, Drilling, Boring, Reaming, Tapping, Lathe, Shaper, Milling, Grinding, Abrasive machining, Finishing, Planing, Broaching, Gear manufacture etc.
6. Introduction to Numerical Control (NC) and Computer-Aided Design & Manufacturing (CAD/CAM).
7. Surface treatment and finishing
   Painting, Galvanizing, Cold galvanizing, Epoxy coating, Electroplating, etc., Powder spray technology and its use as a refilling and repair technology.
8. Engineering metrology and instrumentation
   Basic measuring instruments in precision metrology, Tolerances, Limits and fits, Measurement of surface texture and geometric errors, Coordinate measuring machine, Advanced measuring instruments.

<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>Pre-requisites</td><td>None</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>3/1</td><td></td><td></td></tr>
<tr><td colspan="7">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 electro-magnetic and electrostatic principles.</td></tr>
<tr><td colspan="7">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
One experiment may cover more than one of the above areas and would be conducted as part of a system of electrical engineering applications.</td></tr>
</table>

Semester 3

Module Code	**MA2012**	Module Title	**Differential Equations**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**MA1022**
GPA/NGPA	**GPA**		Lab/Tutorials	**–**		

Learning Outcomes

1. To approximate periodic function using Fourier series.
2. To solve various categories of Partial differential equations appears in physical system modelling.
3. To apply Lap lace Transform and Fourier Transform method to solve differential equation.
4. To apply series solution method to differential equation with variable coefficient.

Outline Syllabus

1. Fourier Series approximation
   Fourier coefficients, Dirichlet's condition, odd and even function, half range series. Trigonometric approximation to discrete data.
2. Partial Differential Equations
   Classification of second-order partial differential equations. Solutions by separation of variables. Fourier series application to boundary value problems.
3. Laplace Transform and applications
   Laplace transform of elementary functions and some basic theorems on Laplace transform. Application of Laplace transforms to solution of differential equations and system of differential equations, transfer functions, convolution theorem, concepts of stability and controllabity.
4. Fourier Transform and applications
   Non-periodic function, Fourier transform, properties of Fourier transform and applications.
5. Ordinary linear differential equations with variable coefficients
   Solution in series, Special function (e.g. Bessel, Legendre) singular points, Existence and uniqueness of the solution(elementary discussions without proof.

Module Code	**MA2022**	Module Title	**Calculus**			
Credits	**2.0**	Hours/ Week	Lectures	**2.0**	Pre-requisites	**MA 1012** **MA1022**
GPA/NGPA	**GPA**		Lab/Tutorials	**–**		

Learning Outcomes

1. To do vector differentiation and integration and to find vector and scalar quantities such as Div, Grad, Curl.
2. To understand the meaning of Div, Grad, Curl and its applications.
3. To apply three important theorems , Divergence, Strokes and Green, in various situations.
4. To apply Cauchy's integral formula.
5. To perform contour integration techniques.
6. To apply conformal mapping in physical system modelling.

Outline Syllabus

1. Vector Calculus

Vector differentiation and differential operators,space curves and line integral, surface and surface integrals. Divergence theorem, Stroke's theorem, Greens theorem in plane. Some basic applications.
2. Complex Variables
Analytical function and Cauchy-Reimann equation, Cauchy's integral formula and applications. Taylor and Laurent's series, contour integration. Introduction to conformal mapping.

Module Code	**EE2012**	Module Title	**Circuit Theory**			
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. 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.

Module Code	**EE2022**	Module Title	**Electrical Machines and Drives 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. 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 Systems 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.

Module Code	**EN2012**	Module Title	**Analog Electronics**			
Credits	**2.5**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**3/2**		

Learning Outcomes

At the end of the module the student will be able to;

1. Examine the behavior of BJT and FET amplifiers in low, mid and high frequency ranges.
2. Design transistor amplifiers to meet given specifications.
3. Explain the differential amplifying concepts.
4. Identify the functionality and applications of operational amplifier circuits.
5. Identify different power amplifier classes and their characteristics.
6. Perform power calculations for power amplifiers.
7. Identify power electronic devices, their construction, operation and applications.

Outline Syllabus

1. Analysis of transistor circuits
   Analysis of transistor circuits at DC, biasing circuits for BJTs and FETs, transistor as an amplifier, single-stage BJT/FET amplifier configurations, small-signal models, small signal mid-frequency equivalent circuits and analysis, low frequency and high frequency equivalent circuits of BJT/FET circuits, h-parameter model, pole zero analysis, Bode plots, frequency response of amplifiers, multistage amplifiers.
2. Differential amplifiers
   The BJT differential pair, small-signal operation of the BJT differential amplifier, characteristics of a differential amplifier, differential amplifier with active load.
3. Operational amplifiers
   Ideal opamp, negative feedback in opamp circuits, operational amplifier specifications, opamp applications, practical behavior of opamps, instrumentation amplifiers.
4. Power amplifiers
   Definitions, applications and types of power amplifiers, power transistors, transistor power dissipation, amplifier classes and their efficiency, push-pull amplifiers, harmonic distortion and feedback, heat generation of power transistors and heat sinks.
5. Power electronic devices and circuits
   Properties and applications of thyristors, triacs, diacs, uni-junction transistors, power

MOSFETs, IGBTs and thermionic valve, power electronic circuits such as power controllers, Cdi.

Module Code	**EN2022**	Module Title	**Digital Electronics**			
Credits	**2.5**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**3/2**		

Learning Outcomes
At the end of the module the student will be able to

1. Design combinational and sequential digital circuits.
2. Differentiate characteristics of logic families.
3. Compare usage of different logic families.
4. Use programmable devices in digital circuits.
5. Compare different types of analog-to-digital and digital-to-analog converters.

Outline Syllabus

1. Combinational and sequential logic circuits
   Five variable Karnaugh maps, Quine–McCluskey method, flip-flops, latches, counters, registers and other MSI devices, design of finite state machines.
2. Logic families
   Ideal logic gates, logic levels and noise margins, dynamic response of logic gates, Analysis of logic families (fan-in, fan-out), diode logic, logic families (DTL, TTL, ECL, CMOS).
3. Programmable devices
   Programmable logic devices, PLAs, PALs, GALs, RAM and ROM chips, microcontrollers.
4. Conversion circuits
   ADC, DAC, types dual slope, successive approximation etc., common chips available.

Module Code	**ME2012**	Module Title	**Mechanics of Materials I**			
Credits	**2.0**	Hours/Week	Lectures	**1.5**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**3/2**		

Learning Outcomes
After completing this module, the students should be able to

1. explain the basic concepts and laws of Mechanics of Materials and their application in the analysis and design of actual engineering structures and machine components
2. analyse certain problems of particular Mechanical Engineering interest with emphasis on their importance to safe design
3. recognize the relevance of these concepts in understanding the subject ME 2142 Machine Elements & Innovative Design.

Outline Syllabus

1. Introduction
   Types of engineering components, Different forms of loading and support conditions, Types of joints.
2. Concept of stress
   Static equilibrium , Internal forces, Direct stress, Shear stress, Uni-axial stress systems
3. Introduction to Elasticity : Stress and strain

Direct and shear strains, Deformations, Displacements, Boundary conditions, elastic properties of materials, Hooke's Law, Poisson's Ratio, Thermal strain and deformation, Saint-Venant's Principle, Statically indeterminate problems. Elastic strain energy, Thin-walled spherical and cylindrical pressure vessels.

4. Bending of Beams
   Shear forces & bending moments in beams, Theory of simple bending, Bending stress distribution, Combined loading.
5. Torsion of circular bars
   Torsional shear stress distribution in circular bars, Angle of twist, Torsional strain energy applications: shaft coupling, propeller shafts.
6. 2D Stress transformation
   Transformation of stresses in 2D problems, Principal stresses, Mohr's circle of stress, combined loading.
7. Deflection of beams
   Moment-curvature relation, Governing differential equation, Direct integration solutions, Singularity functions.
8. Buckling Instability of Columns
   Euler critical loads for combinations of free, pinned and built-in end conditions, limiting stress conditions.

Module Code	**CE1822**	Module Title	**Aspects of Civil Engineering**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	–		

Learning Outcomes

1. Ability to understand the construction of a two storied house and supervise the quality and the cost effectiveness.
2. Ability to understand common building defects and their rectification methods.
3. Ability to understand the basic principles of land surveying

Outline Syllabus

1. Introduction to common civil engineering structures.
2. Identification of building materials with respect to the quality, application and their cost.
3. Identification building elements and their construction procedure for a two storied house.
4. Introduction to building services including water, sanitary facilities, electricity, fire fighting, vertical circulation.
5. Introduction to common defects in buildings and their rectification methods
6. Introduction to ICTAD specifications
7. Introduction to surveying methods and surveying applications.
8. Setting out and vertical control for buildings.
   Assignments.
   Reports based on field visits.

Module Code	**EE2092**	Module Title	**Laboratory Practice III**			
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 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

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

Semester 4

Module Code	**MA2032**	Module Title	**Linear Algebra**			
Credits	**2**	Hours/Week	Lectures	**2.0**	Pre-requisites	**MA1022**
GPA/NGPA	**GPA**		Lab/Tutorials	–		

Learning Outcomes

1. Reduce a matrix using Gauss-Jordan reduction
2. Solve a system of n equations and m variables
3. Find the inverse of a matrix
4. Understand the dimension of a vector space, rank of a matrix and basis for a vector space.
5. Understand the concept of linear independence, linear transformation and determinants
6. Find eigenvalues and eigenvectors, and diagonalize quadratic forms.

Outline Syllabus

Vectors spaces, subspaces, linear combinations, spanning sets, linear independence, and bases. Column space and row space and null space of a matrix and application. Linear transformation. Eigen values, eigen vectors and related topics. Diagonalisation of matrices. Quadratic forms.

Applications.

Numerical Linear Algebra.

Module Code	**MA2042**	Module Title	**Discrete Mathematics**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**MA1022**
GPA/NGPA	**GPA**		Lab/Tutorials	–		

Learning Outcomes

1. To apply logic and Boolean algebra in circuit design and network and other applications.
2. To apply graph theory in devising various search algorithms and other algorithm applied in computing.
3. To apply discrete mathematics concepts in other areas such as Operational Research.

Outline Syllabus

1. Logic
   Symbolic statements and truth tables, conditional connectives, Some methods of proof. Boolean Algebra: disjunctive and conjunctive normal forms, Karnaugh maps, minimization and applications.
2. Introduction to Graph Theory
   Basic definitions, degree of a vertex, paths, cycles and connectivity. Digraphs and relationship graphs. Isomorphism of graphs, adjacency, matrices and adjacency lists. Planar graphs Coloring of graphs. Trees: Properties, spanning trees, rooted trees, binary trees, binary search and applications
3. Miscellaneous
   Recurrence relations, Basic Algebraic Structures and applications, Grammars, languages and Automaton.

Module Code	EE2132	Module Title	Electromagnetic Field Theory			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Co-requisite	**EE1092**
GPA/NGPA	**GPA**		Lab/Assignment	**–**		

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.

Module Code	EE2042	Module Title	Electrical Measurements and Instrumentation			
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. 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.

Module Code	**EE2052**	Module Title	**Control Systems I**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Co-requisites	**EE2192**
GPA/NGPA	**GPA**		Lab/Assignment	–		

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. Modelling 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	**EE3072**	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, bill

of quantities, 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.

Module Code	**EE2072**	Module Title	**Electrical Machines and Drives II**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Co-requisites	**EE2192**
GPA/NGPA	**GPA**		Lab/Assignment	–		

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).

Module Code	**EE2082**	Module Title	**Power system II**			
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. 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. analyse 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.

Module Code	**ME2852**	Module Title	**Basic Thermal Sciences and Applications**			
Credits	**3.0**	Hours/Week	Lectures	**2.5**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**3/2**		

Learning Outcomes

After completing this module, the students should be able to

1. explain the basic thermodynamic principles.

2. use Thermodynamic Property Tables.
3. use the relevant properties to calculate non-property quantities in Thermodynamic systems.
4. apply the laws of thermodynamics to basic processes.
5. apply basic knowledge of heat transfer to analyse simple engineering problems.
6. use the psychrometric property chart to do basic calculations.
7. carry out basic estimations related to power cycles.

Outline Syllabus

1. Basic Principles
   Review of Boyle's law, Charles's law etc. Forms of energy and their transformations, Heat and Work as methods of Energy transfer, the statistical nature of thermodynamics, types of systems.
2. Properties of Substances
   Importance of Thermodynamic properties, Intensive and Extensive properties, Concept of Thermodynamic state, Thermodynamic Equilibrium. Difference between ideal and real substances, Thermodynamic Property tables.
3. Fundamental laws of thermodynamics
   First Law of Thermodynamics, First law with reference to principal system types, Internal energy as a consequence of the First law. Reversible process, Second law of thermodynamics, Entropy as a consequence of the Second law.
4. Processes
   Basic types of processes, Processes as transition of Thermodynamic states, Property Diagrams, Reversible and Irreversible processes, Cyclic Processes.
5. Heat Transfer
   Mechanisms of heat transfer, Heat transfer applications in Engineering.
6. Psychrometrics
   Thermodynamic properties in Psychrometrics, Estimations using psychrometric charts.
7. Power Cycles
   Idealised gas & vapour power cycles and performance indices, Basic estimations.

Module Code	**EE2192**	Module Title	**Laboratory Practice IV**			
Credits	**1.0**	Hours/Week	Lectures	**None**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignemnt	**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 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>None</td><td>Pre-requisites</td><td>None</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Assignment</td><td>6/1</td><td></td><td></td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td colspan="7">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.</td></tr>
</table>

Semester 5

Module Code	**MA3012**	Module Title	**Applied Statistics**			
Credits	**02**	Hours/Week	Lectures	**2.0**	Pre-requisites	**MA1022**
GPA/NGPA	**GPA**		Lab/Tutorials	–		

Learning Outcomes

1. Identify the role of probability and statistics in their discipline area.
2. Perform a range of statistical procedures related to the manipulation and interpretation of data.
3. Distinguish between types of statistical tests that may me used to analyse data.
4. Demonstrate basic knowledge of assessing the appropriateness of statistical models.
5. Demonstrate practical expertise associated with the use of statistical package in performing basic statistical procedure.

Outline Syllabus

1. Discrete and continuous random variables
   Expectation, mean and variance of Bernoulli, Geometric, Binomial, Poisson, Uniform, Exponential and Normal Distributions.
2. Statistical Inference
   Sampling distributions, central limit theorem, confidence intervals for mean and variance. Hypothesis tests for mean. Difference between means, proportions and variance. Goodness-of-fit tests and contingency table. Regression, correlation, least square estimation and hypothesis tests in simple linear regression. Introduction to Quality Control, O.C Curve. Control charts, attribute type sampling schemes. Variable type sampling schemes.
3. Practical Work
   Use of MINITAB for statistical testing and regression analysis.

Module Code	**MA3022**	Module Title	**Numerical Methods**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**MA1022**
GPA/NGPA	**GPA**		Lab/Tutorials	–		

Learning Outcomes

1. To apply simple search and simple gradient methods in optimizing multivariable function.
2. To apply Taylor series to derive various implicit and explicit algorithm in solving ODE.
3. To compare different algorithm in terms of implementation in computers, and accuracy.
4. To apply different numerical scheme to find solution of different types of PDE.
5. To apply FEM in solving simple problems.

Outline Syllabus

Numerical optimization problems (direct search and simple gradient methods). Solution of set of non-linear equations. Matrix eigenvalue determination including direct, inverse iteration and shift of origin, special methods for dealing with band type and sparse matrices. Simple error analysis, convergence properties.

Simple finite difference technique for initial-value and boundary-value problems in ordinary and partial differential equations and systems. Phase plane and isoclinal curves. Taylor series, Runge-Kutta process.

Explicit and implicit procedures, simple ideas on errors and stability.
Introduction to method of characteristics. Finite Element Methods.
Practical Work: Use of published algorithms and packages for solving numerical problems.

Module Code	**MN 3042**	Module Title	**Business Economics and Financial Accounting**			
Credits	**3.0**	Hours/Week	Lectures	**3.0**	Prerequisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	–		

Learning Outcomes

1. To define the basic micro and macro economic concepts. Identify of the links between economy and technology.
2. To define basic concepts in financial, cost and management accounting.
3. To apply basic knowledge on these accounting concepts to business environment and to interpret main accounting statements.

Outline Syllabus

1. Business Economics
   Economics and the economy; Elementary theory of Economics; Tools of economic analysis; Demand, supply and the market; Theory of the firm; Different types of firms; Motivation of firms; Theory of supply; Costs and production; Introduction to macroeconomics and national income accounting.
2. Financial and cost Accounting
   Basic accounting concepts; Trial balance; Profit & loss account, balance sheet; Cash flow statements; Interpretation of accounts; Cost concepts and terminology; Analysis and interpretation of cost; Allocation of overheads; Marginal costing, CPV analysis; Standard costing; Stock control.

Module Code	**EE3012**	Module Title	**High Voltage Engineering I**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Co-requisites	**EE3092**
GPA/NGPA	**GPA**		Lab/Assignment	–		

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.

Module Code	**EE3022**	Module Title	**Control Systems II**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Co-requisites	**EE3092**
GPA/NGPA	**GPA**		Lab/Assignment	**–**		

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. comparison of 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).

Module Code	EE3042	Module Title	**Power system III**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Co-requisites	**EE3092**
GPA/NGPA	**GPA**		Lab/Assignment	–		

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.

Module Code	**EE3052**	Module Title	**Power Electronics and Applications I**			
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. 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 in industry.
4. AC voltage regulators
Static ac voltage regulators for low and high power applications.

Module Code	**EE3062**	Module Title	**Energy Systems**			
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. 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.

Module Code	EE3902	Module Title	**Communication and Presentation Skills**			
Credits	**1.5**	Hours/Week	Lectures	**1.5**	Pre-requisites	**None**
GPA/NGPA	**NGPA**		Lab/Assignment	–		

Learning Outcomes
After completing this module the student should be able to
1. read critically and analyse 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.

Semester 6

Module Code	**EE3992**	Title	**Industrial Training**			
Credits	**6.0**	Hours/Week	Lectures	**None**	Pre-requisites	**None**
GPA/NGPA	**NGPA**		Training	**24 weeks full time**		

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 practices.
6. Systems approach.
7. Management.

Semester 7

Module Code	MN 3052	Module Title	Industrial Management and Marketing			
Credits	**3.0**	Hours/Week	Lectures	3.0	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	–		

Learning Outcomes

1. To describe basic concepts and theories of organizational management. To explain the application of these theories for modern organizations.
2. To describe the fundamentals of technology management, human resource management and legal issues related to modern industrial relations.
3. To explain basic marketing concepts and theories and their applications.

Outline Syllabus

1. Organization management
   Introduction to management & systems theory; Organizational theory; stakeholder analysis, organizational vision, mission & objectives. Types of organizations; organizational strategy, structures of modern organization and the concept of learning organization; Different roles of manager; manager & leader. Organizational culture & control; concepts of authority, power, responsibility & their applications and management of conflict. Management of change; importance of change management and conflict management. Modern management techniques; management styles: Japanese vs. Western Systems.
2. Technology management
   Technology and economic development; Key concepts of technology management and its relation to business management; Technology and competitive advantage; Evaluating technology;
3. Human Resource Management and Industrial Relations (6 hrs)
   Introduction to human resource management, Employee selection, performance evaluation, rewards, Human resource development, Compensation and grievance handling, Labour - Management Relations in Sri Lanka and Business Ethics.
4. Marketing
   Marketing: overview; Marketing environment, marketing research and product life cycles; Buyer behavior: consumer and organizational; 4Ps of marketing including promotion and communication issues.

Module Code	MN 4022	Module Title	Engineering Economics			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**–**		

Learning Outcomes

1. To identify the most relevant economic concepts for the engineering decisions.
2. To apply these concepts to practical engineering projects and decisions.

Outline Syllabus

1. Fundamentals
   Time value of money, equivalence and cash flow diagrams.
2. Discounted cash flow
   Time value equivalence, single payment and annuity factors and numerical examples. Cash flows and compounding.

3. Comparison methods
   Assumptions, net present value, annual worth, equivalent annual cost with/without salvage value, equivalent annual worth of fixed asset lives and perpetual lives, internal rate of return (IRR) and minimum acceptable rate of return and IRR irregularities, numerical examples.
4. Analysis of alternatives
   Classification, mutually exclusive alternatives, incremental analysis and preferred method for decision making.
5. Project feasibility analysis
   Financial feasibility, market price analysis, cost of capital and weighted average, economy feasibility, shadow pricing, benefit cost (B/C) analysis, irregularities of B/C analysis and preferred method for decision making.
6. Sensitivity analysis and decision trees
   What if?, sensitivity graph and interpretation of the analysis, discounted decision trees and application of decision trees.
7. Risk management
   Risk identification, risk analysis and risk response.

Module Code	**MN 4042**	Module Title	**Technology Management**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	**–**		

Learning Outcomes
1. To recognize basic concepts and theories of management of technology.
2. To identify the usage of MOT concepts and theories in modern organizations and economy.

Outline Syllabus
Concept of technology Management
1. Strategic management of technology; (4 hrs)
   Technology-strategy relationship.
   Elements of technology strategy and formulation of a technology strategy.
   Integration of technology strategy and business strategy for competitive success.
   Technology, the environment and sustainable development.
2. Organizational Aspects of technology management; (4 hrs)
   Human dimension of technology and concepts of the entrepreneur and entrepreneur.
   Organizational cultures and structures for promotion of creativity and innovation.
   The learning organization.
   The imperative of knowledge management.
3. Acquiring technology through technology transfer; (3 hrs)
   Motivations for acquiring technology through technology transfer.
   Elements of technology transfer process.
   Success and failure factors in technology transfer.
4. Acquiring technology through research and development; (3 hrs)
   The concepts of invention and innovation.
   Definition and classifications of research and development.
   New product development.
   Challenges in commercializing research results.
5. National innovation systems for facilitating technology-based development (4 hrs)
   Concepts of the national innovation system (NIS) and science and technology infra-

structure. Comparison of NISs of developed, developing and first and second tier NIC countries. State involvement and growth of science and technology parks in developed and developing countries. 6. Practicals Four industry case studies, Two plant/laboratory visit.

Module Code	**EE4012**	Module Title	**Automation and Control Technologies**			
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. 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 in Automation.

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
   Computer aided spatial design, drawing primitives, making 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.

Module Code	**EE4032**	Module Title	**Electrical Installation II**			
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. 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

Module Code	**EE4042**	Module Title	**Electrical Machines and Drives IV**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Co-requisites	**EE4092**
GPA/NGPA	**GPA**		Lab/Assignment	–		

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, co-ordination 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 set up for the power system whilst meeting the desired needs.
3. analyse 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 modelling.
7. System stability and load shedding
   Effect on system stability by adding generators and loads, load shedding criterion and design of load shedding scheme.

Module Code	**EE4202**	Module Title	**Design Project**			
Credits	**5**	Hours/Week	Lectures	**None**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignment	**10/1**		

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.

Module Code	**EE4092**	Module Title	**Laboratory Practice VII**			
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 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	**None**	Pre-requisites	**None**
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, switch yards, electrical installations, electrical manufacturing plants, renewable energy plants.
2. Preparation of report.

Semester 8

Module Code	**MN4072**	Module Title	**Small Business Management and Entrepreneurship**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	–		

Learning Outcomes

1. To describe the theoretical and empirical framework of small business management.
2. To explain the applications of these concepts & theories for own business. To identify the necessary skills to become a successful entrepreneur.

Outline Syllabus

1. Small Business Management
   Scale, nature & role of small business in a developing country;
   - Characteristics of small businesses;
   - Role of small businesses;
   - Reasons for failure of small businesses & barriers in establishing and managing small businesses.

   Business environment and industrial supporting system in Sri Lanka.
   Relevant concepts to understand business creation and growth such as;
   - Identification of market opportunities;
   - Developing a business plan;
   - Managing small business operations
   - Marketing in small businesses
2. Entrepreneurship
   Identifying who the entrepreneur is;
   - Definition;
   - Relevant economic, psychological and sociological theories of entrepreneurship;
   - Characteristics and functions of the entrepreneur;
3. Entrepreneurship development;
4. Practical: 6 industrial case studies, guest lectures and assignments

Module Code	**MN4092**	Module Title	**Management Skills Development**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignments	–		

Learning Outcomes

1. To practice and demonstrate capabilities in intra-personal, interpersonal and people management skills that are required in modern organizations.

Outline Syllabus

1. Intra-personal Skills
   Developing self awareness; Values, cognitive style. Attitude towards change and inter-personal orientation;
   Managing stress; Major elements of stress, eliminating stress and temporary stress reduction techniques;
   Effective problem solving skills; to provide a framework for rational problem solving;
2. Interpersonal Skills
   Supportive communication; definition, principles of supportive communication, principles of supportive listening;

Motivating employees; performance, diagnosing work performance problems and enhancing ability, creating a motivating environment; Managing conflict; interpersonal conflict management, conflict response alternatives and collaborative approach for conflict resolution; 3. People Management Skills Leadership; characteristics, styles of leadership, contingent approach and its variable; Empowerment; inhibitors to empowerment, dimensions of empowerment and developing empowerment; Delegation; advantages of delegation, when and whom to delegate and how to delegate effectively; Teamwork; developing teams and teamwork, advantages of teams and stages of team development.

Module Code	**MN4122**	Module Title	**Human Resource Management and Industrial Relations**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	None
GPA/NGPA	**GPA**		Lab/Assignments	–		

Learning Outcomes

1. Acquire and develop capabilities in human resource management concepts and application.

Outline Syllabus

1. Human Resource Management
   - Role of the human resource function and practitioner.
   - Organization, jobs and roles.
   - Employee resourcing.
   - Performance management.
   - Human resource development.
   - Rewarding people.
2. Industrial Relations
   - Labour – Management relations in Sri Lanka.
   - Industrial dispute.
   - Trade unions.
   - EPF, ETF and Gratuity acts.
   - Work place health, safety and welfare.
   - Business ethics.

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, Types 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.

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.
2. 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 build up, 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.

3. Simulation of power electronic systems
   Use of standard simulation packages.
4. Applications
   Details of selected applications of power electronics in power systems, industrial processes, motion control systems, power supplies, artificial lighting etc.

Module Code	**EE4202**	Module Title	**Design Project** (Continued from Semester 7)			
Credits	**5**	Hours/Week	Lectures	**None**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignment	**10/1**		

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.

Module Code	**EE4192**	Module Title	**Laboratory Practice VIII**			
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 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	EE4082	Module Title	Robotics and Mechatronics			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Co-requisites	**EE4192**
GPA/NGPA	**GPA**		Lab/Assignment	–		

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.

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.

Module Code	**EE4712**	Module Title	**Realtime Computer Systems**			
Credits	**2.0**	Hours/Week	Lectures	**2.0**	Pre-requisites	**None**
GPA/NGPA	**GPA**		Lab/Assignment	–		

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.

Module Code	**MA4022**	Module Title	**Operational Research**			
Credits	**3.0**	Hours/Week	Lectures	**3.0**	Pre-requisites	**MA1012**
GPA/NGPA	**GPA**		Lab/Tutorials	–		

Learning Outcomes
1. To apply appropriate OR techniques in a given real world problem.
2. To perform sensitivity analysis in the chosen OR model.
3. To choose appropriate algorithm given the OR technique.
4. Usage of specific and generic software.

Outline Syllabus

Modeling with linear programming, geometrical solution to problems with two decision variables, the simplex method including the two phase method of a solution of problems with mixed constraints. Duality. Transpiration and Assignment problems. Theory of zero sum, two person matrix games.

Revised simplex algorithm. Dual Simplex algorithm, sensitivity analysis and parametric programming. Integer programming, Gomory's cutting plane, branch and bound, the knapsack problem. .Dynamic programming, the inventory model. Non-linear optimization. Introduction to network algorithm including minimum connector problems: Shortest and longest path algorithms and critical path analysis.

<table>
<tr><td>Module Code</td><td>MA4032</td><td>Module Title</td><td colspan="4">Time Series and Stochastic Processes</td></tr>
<tr><td>Credits</td><td>3.0</td><td rowspan="2">Hours/Week</td><td>Lectures</td><td>3.0</td><td>Pre-requisites</td><td>MA1022
MA3012</td></tr>
<tr><td>GPA/NGPA</td><td>GPA</td><td>Lab/Tutorials</td><td>–</td><td></td><td></td></tr>
<tr><td colspan="7">Learning Outcomes
1. To choose the appropriate time series modeling technique for a given data.
2. To forecast in management and engineering applications.
3. To compare different time series analysis techniques in terms of forecasting accuracy.
4. To apply Markov chain techniques in modeling uncertain physical system.
5. To apply Stochastic modeling techniques in OR problem such as Queuing and Waiting line models.</td></tr>
<tr><td colspan="7">Outline Syllabus
1. Time Series
Basic theory of stationary process; AR, MA, and ARMA models; seasonal adjustment. Some application in social and physical sciences.
2. Stochastic Process
An introduction to stochastic processes. Probability generating functions. Homogeneous Poisson process, Birth-Death process, stationary distributions, queuing theory, Markov chains.</td></tr>
</table>

Service Course

(Not available to Electrical Engineering field of specialisation)

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.

Electrical Engineering Society – EESoc

Electrical Engineering Society (EESoc) is a group of progressive power people from University of Moratuwa, who aim to produce dynamic personnel in the field of Electrical Engineering. EESoc was inaugurated on the 27th October 1994 with Professor Rohan Lucas as its founder President. While still being a very young society, EESoc's achievements are so impressive because all of us always "Try for Excellence ".

EESoc is blessed with warm thoughts, simple pleasures, and simple joys. We believe that happiness comes from feeling deeply, enjoying simply and thinking freely. EESoc knows that all the power products of University of Moratuwa are still up there, all exactly where they are supposed to be. The EESoc Calander includes the following events which take place at regular intervals.

- AGM and Get-together
- We are with you program
- EESoc award for best project
- EESoc Lecture series

The AGM and Get-together

The Annual General Meeting of EESoc, is a time to look back and savour our achievements while planing our activities for the next year. An event to look forward to in our activity calendar which brings together professionals in the field of Electrical Engineering and the undergraduates to a very informal setting to build or refresh relationships between one another.

We are with You

We are with You is a very special social responsibility program organized by EESoc for the benefit of deaf students. It is sad that the community has forgotten the importance of these young children, and they often do not get involved in common functions. They are like all the other ordinary children in every other way, only thing they lack is, that they don't hear as we do and they can't express themselves in the ordinary way of talking. Yet they are skilled in many other ways like in studies, in painting and other creative work, in sports etc. Though the Schools for deaf are funded by various organizations, what these students lack are the thoughts of love and caring from the community.

Several entertainment programs as well as educational programs are organized for the students, during their visit to the campus, including an art exhibition, magic show, sports carnival and a movie session.

The origins of this programme dates back to the time of Miss Indunil Weeraratne. While being an Electrical Engineering Student she and a group of friends in the year 2000 organized a programme at the Ratmalana School for the Deaf. Since then the event has been taken over by the Electrical Engineering Society on her request, and organized annually with the participation of other deaf schools.

EESoc Award for Best Project

The Electrical Engineering Society has donated an award for Excellence in Performance of the Final Year Undergraduate Project in Electrical Engineering. This award is annually given at the Academic Award Ceremony of the University of Moratuwa to selected students from the Department judged by the Electrical Engineering Department as the best undergraduate project during the year. The award was inaugurated by the 1992/93 Final year students.

EESoc Lecture Series

EESoc organises a monthly lecture series, to provide assistance in updating the knowledge of our members with new technology. Guest speakers from the industrial sector and from the other universities are invited regularly to share their thoughts, knowledge and expertise with the students.