AC - 26/2/2015, item No. 4.65

UNIVERSITY OF MUMBAI

Bachelor of Engineering

Electronics and Electrical Engineering

(Second Year – Sem. III & IV)

Effective from Academic Year 2015 -16,

Under

FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)

Deans Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

Dr. S. K. Ukarande
Dean,
Faculty of Technology,
Member - Management Council, Senate, Academic Council
University of Mumbai, Mumbai

Preamble:

The engineering education in India in general is expanding in manifolds. Now, the challenge is to ensure its quality to the stakeholders along with the expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. An engineering program must ensure that its graduates understand the basic concepts of science and mathematics, have gone through one engineering field in dept of appreciate and use its methodologies of analyses and design, and have acquired skills for lifelong learning.

An engineering program must therefore have a mission statement which is in conformity with program objectives and program outcomes that are expected of the educational process. The outcomes of a program must be measureable and must be assessed regularly through proper feedback for improvement of the programme. There must be a quality assurance process in place within the Institute to make use of the feedback for improvement of the programme. The curriculum must be constantly refined and updated to ensure that the defined objectives and outcomes are achieved. Students must be encouraged to comment on the objectives and outcomes and the role played by the individual courses in achieving them. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, as Chairman, Board of Studies in Electronics Engineering University of Mumbai, is happy to state here that, Program Educational Objectives were finalized in a meeting where more than 20 members from different Institutes have attended, who were either Heads or their representatives of Electronics Engineering Department. The Program Educational Objectives finalized for undergraduate program in Electronics Engineering are listed below;

• To provide students with a strong foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyse engineering problems at hand and to prepare them for graduate studies.

• To prepare students to demonstrate an ability to identify, formulate and solve electronics engineering problems.

• To prepare students to demonstrate ability to design electrical and electronics systems and conduct experiments, analyze and interpret data.

• To prepare students to demonstrate for successful career in industry to meet needs of Indian and multi-national companies.

• To develop the ability among students to synthesize data and technical concepts from applications to product design.

• To provide opportunity to students to work as part of teams on multidisciplinary projects.

• To promote awareness among students for the life-long learning and to introduce them to professional ethics and codes of professional practice.

In addition to above more program educational objectives of their own may be added by affiliated Institutes and Heads of Departments.

In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

Dr. Dileep G. Borse

M. Tech. Ph. D. (IIT Bombay)

Convener, Syllabus Committee, Electronics and Electrical Engineering

University of Mumbai

Program Structure for B E Electronics and Electrical Engineering
S. E. Electronics and Electrical Engineering - (Semester III)

[Proposed Discipline Code (First two digits) for Electronics and Electrical Engineering is: **"EL"**]

Sub Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELC301	Applied Mathematics - III	04	--	01#	04	--	01	05
ELC302	Electronic Devices & Circuits	04	--	--	04	--	--	04
ELC303	Electrical Network	04	--	--	04	--	--	04
ELC304	Electronic Instruments & Measurements	04	--	--	04	--	--	04
ELC305	Conventional & Non-Conventional Power Generation	04	--	---	04	--	---	04
ELL301	Electronic Devices & Circuit Laboratory	--	02	--	--	01	--	01
ELL302	Network & Measurement Laboratory	--	02	--	--	01	--	01
ELL303	Object Oriented Programming Methodology Laboratory	--	02 + 02*	--	--	02	--	02
Total		20	08	01	20	04	01	25

*2 Hours be converted to theory for entire class and 2 hour for hands on practice.
Tutorials will be conducted Batch-wise

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
ELC301	Applied Mathematics - III	20	20	20	80	3	25		125
ELC302	Electronic Devices & Circuits	20	20	20	80	3			100
ELC303	Electrical Network	20	20	20	80	3			100
ELC304	Electronic Instruments & Measurement	20	20	20	80	3			100
ELC305	Conventional & Non-Conventional Power Generation	20	20	20	80	3			100
ELL301	Electronic Devices & Circuit Laboratory						25	25	50
ELL302	Network & Measurement Laboratory						25	25	50
ELL303	Object Oriented Programming Methodology Laboratory						25	50	75
Total				**100**	**400**		**100**	**100**	**700**

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./Tut.	Theory	Pract./Tut.	Total
ELC 301	Applied Mathematics-III	04	01	04	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
ELC301	Applied Mathematics-III	20	20	20	80	3	25		125

Subject Code	Subject Name	Credits
ELC 301	**Applied Mathematics III**	**05**
Course Objectives	• To provide students with a sound foundation in Mathematics and prepare them for graduate studies in Electronics and Electrical Engg. • To provide students with mathematics fundamental necessary to formulate, solve and analyze engg. problems. • To provide opportunity for students to work as part of teams on multi disciplinary projects.	
Course Outcomes	• Students will demonstrate basic knowledge of Laplace Transform. Fourier series, Bessel Functions, Vector Algebra and Complex Variable. • Students will demonstrate an ability to identify formulate and solve electronics and telecommunication Engg. Problem using Applied Mathematics. • Students will show the understanding of impact of Engg. Mathematics on Electronics and Electrical Engg. • Students who can participate and succeed in competitive exams like GATE, GRE.	

Module No.	Unit No.	Topics	Hrs.
1. 0		**Laplace Transform**	12
	1.1	**Laplace Transform (LT) of Standard Functions:** Definition. unilateral and bilateral Laplace Transform, LT of *sin(at), cos(at),* e^{at}, t^{n}, *sinh(at), cosh(at), erf(t),* Heavi-side unit step, dirac-delta function, LT of periodic function	

	1.2	**Properties of Laplace Transform:** Linearity, first shifting theorem, second shifting theorem, multiplication by t^n, division by t, Laplace Transform of derivatives and integrals, change of scale, convolution theorem, initial and final value theorem, Parsavel's identity	
	1.3	**Inverse Laplace Transform:** Partial fraction method, long division method, residue method	
	1.4	**Applications of Laplace Transform:** Solution of ordinary differential equations	
2.0		**Fourier Series**	**10**
	2.1	**Introduction:** Definition, Dirichlet's conditions, Euler's formulae	
	2.2	**Fourier Series of Functions:** Exponential, trigonometric functions, even and odd functions, half range sine and cosine series	
	2.3	Complex form of Fourier series, orthogonal and orthonormal set of functions, Fourier integral representation	
3.0		**Bessel Functions**	**08**
	3.1	**Solution of Bessel Differential Equation:** Series method, recurrence relation, properties of Bessel function of order +1/2 and -1/2	
	3.2	Generating function, orthogonality property	
	3.3	Bessel Fourier series of functions	
4.0		**Vector Algebra**	**12**
	4.1	**Scalar and Vector Product**: Scalar and vector product of three and four vectors and their properties	
	4.2	**Vector Differentiation:** Gradient of scalar point function, divergence and curl of vector point function	
	4.3	**Properties:** Solenoidal and irrotational vector fields, conservative vector field	
	4.4	**Vector Integral:** Line integral, Green's theorem in a plane, Gauss' divergence theorem, Stokes' theorem	
5.0		**Complex Variable**	**10**
	5.1	**Analytic Function:** Necessary and sufficient conditions, Cauchy Reiman equation in polar form	
	5.2	Harmonic function, orthogonal trajectories	
	5.3	**Mapping:** Conformal mapping, bilinear transformations, cross ratio, fixed points, bilinear transformation of straight lines and circles	
		Total	52

Text books:

1. P. N. Wartikar and J. N. Wartikar, *"A Text Book of Applied Mathematic",* Vol. I & II, Vidyarthi Griha Prakashan
2. A. Datta, *"Mathematical Methods in Science and Engineering",* 2012
3. B.S. Grewal, *"Higher Engineering Mathematics",* Khanna Publication

Reference Books:

1. B. S. Tyagi, *"Functions of a Complex Variable,"* Kedarnath Ram Nath Publication
2. B. V. Ramana, *"Higher Engineering Mathematics",* Tata Mc-Graw Hill Publication
3. Wylie and Barret, *"Advanced Engineering Mathematics",* Tata Mc-Graw Hill 6th Edition
4. Erwin Kreysizg, *"Advanced Engineering Mathematics",* John Wiley & Sons, Inc
5. Murry R. Spieget, *"Vector Analysis",* Schaum's outline series, Mc-Graw Hill Publication

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered for final Internal Assessment.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Term Work/ Tutorial:

At least 08 assignments covering entire syllabus must be given during the '**Batch wise tutorial'**. The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every assignment graded from time to time. The grades will be converted to marks as per '**credit and grading system'** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./Tut.	Theory	Pract./Tut.	Total
ELC302	Electronic Devices and Circuits (abbreviated as EDC)	04	00	04	00	04

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
ELC302	Electronic Devices and Circuits	20	20	20	80	3			100

Subject Code	Subject Name	Credits
ELC302	Electronic Devices and Circuits (abbreviated as EDC)	04
Course Objectives	• To teach the basic concept of various electronic devices, circuits and their application • To develop ability among students for problem formulation, system design and solving skills	
Course Outcomes	• Students will be able to build, develop, model, and analyze the electronic circuits along with learning the device ratings and characteristics • Students will be able to design electrical and electronic circuits	

Module	Contents	Hours
1	**Diode:** Construction Principle of operation and application of special diode – 1) Zener, 2) LED, 3) Schottky, 4) Photodoide. Full Wave Rectifier and Filter Analysis: specification of the devices and components required for C, LC, CLC & RC filter.	06
2	**Bipolar Junction Transistor:** Biasing Circuits: Types, dc circuit analysis, load line, thermal runaway, stability factor analysis, thermal stabilization and compensation. Modeling: Small signal analysis of CE configurations with different biasing network using h-parameter model. Introduction to r_e-model and hybrid-pi model. Amplification. Derivation of expression for voltage gain, current gain, input impedance and output impedance of CC, CB, CE amplifiers, Study of frequency response of BJT amplifier.	12
3	**Field Effect Transistor: JFET and MOSFET:** Types, construction and their characteristics, Biasing circuits for FET amplifiers, FET small signal analysis, derivation of expressions for voltage gain and output impedance of CS amplifiers. **MOSFET**- Types, construction and their characteristics	08
4	**Feedback Amplifier:** Introduction to positive and negative feedback, negative feedback -current, voltage, Series and Shunt type. It's effect on input impedance, output impedance, voltage gain, current gain and bandwidth **Cascade amplifiers:** Types of coupling, effect of coupling on performance of BJT and JFET amplifiers, cascade connection, Darlington-pair	09
5	**DC and AC analysis of Differential amplifier**, single and dual inputs and balanced and unbalanced outputs using BJT. FET differential amplifier.	05
6	**Oscillators:** Positive feedback oscillators, frequency of oscillation and condition for sustained oscillations of a) RC phase shift, b)Wien bridge, c)Hartley/ Colpitts with derivations, crystal Oscillator, UJT relaxation oscillator	08
	Total	48

Assessment:
Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Books Recommended:

Text Books:

1. Robert Boylestad and Louis Nashelsky, *Electronic Devices and Circuits*, Prentice-Hall of India.
2. Millman and Halkias, '*Electronic Devices and Circuits*', Tata McGraw-Hill.
3. David Bell, *Electronic Devices and Circuits*, Oxford University Press

Reference Books:

1. Thomas Floyd, '*Electronic Devices'*, Prentice-Hall of India
2. Ramakant A. Gayakwad, *Op-Amps and Linear Integrated Circuits*
3. Neamen D.A., *Electronic Circuit Analysis and Design*, McGraw Hill International.
S. Salivahanan, N. Suresh Kumar, "*Electronic Devices and Circuits" TMH*

Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./Tut.	Theory	Pract./Tut.	Total
ELC303	Electrical Networks (abbreviated as EN)	04	00	04	00	04

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
ELC303	Electrical Networks	20	20	20	80	3			100

Subject Code	Subject Name	Credits
ELC303	Electrical Networks (abbreviated as EN)	04
Course Objectives	• To impart the knowledge of various fundamental techniques for analysis and synthesis of electrical network. • To mould creative engineers needed in education and industrial development along with problem solving skills	
Course Outcomes	• Students will be familiar with the various techniques to analyze electrical systems in transient and steady state conditions. • Will be able to demonstrate skills to use modern engineering tools, software and equipments to analyse problems.	

Module	Contents	Hours
1	**Network Theorems** Solution of network using dependent sources, mesh analysis, super mesh analysis, nodal analysis, super node analysis, source transformation and source shifting, superposition theorem, Thevenin's theorems and Norton's theorem, maximum power transfer theorem. Solution of network with A.C. sources: magnetic coupling, mesh analysis, nodal analysis, superposition theorem, Thevenin's theorems, Norton's theorem, maximum power transfer theorem, Tellegen's theorem, Millman's theorem, reciprocity theorem.	12

2	**Graph theory and network topology** Introduction, graph of network, tree, co-tree, loop incidence matrix, cut set matrix, tie set matrix and loop current, number of possible tree of a graph, analysis of network equilibrium equation, duality.	06
3	**First Order and Second order differential equations** Initial condition of networks, General and partial solutions, time constant, integrating factor, more complicated network, geometrical interpretation of derivative.	06
4	**The Laplace Transform** The Laplace transform and its application to network analysis, transient and steady state response to step, ramp, impulse and sinusoidal input function, transform of other signal waveform, shifted step, ramp and impulse function, waveform synthesis	06
5	**Network Functions; Poles and Zeros** Network functions for one port and two port networks, Driving point and transfer functions, ladder network, General network, poles and zeros of network functions, restrictions on Pole and zero locations for driving point functions and Transfer functions, time domain behavior from pole - zero plot. **Two port parameters** Open circuit, short circuit, transmission and hybrid Parameters, relationships between parameter sets, reciprocity and symmetry conditions, parallel connection of two port networks	12
6	**Network Synthesis** Concept of stability, Hurwitz polynomials, Properties and testing of positive real functions, Driving point synthesis of LC, RC, RL network.	06

Assessment:
Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Books Recommended:
Text Books:
1. W H Hayt, S M Durbin, J E Kemmerly, '*Engineering Circuit Analysis',* 7th Edition Tata McGraw-Hill Education.
2. M. E. Van Valkenburg, '*Network Analysis',* 3rd Edition, PHI Learning.
3. D. Roy Choudhury, '*Networks and Systems',* 2nd Edition, New Age International.
4. M. E. Van Valkenburg, '*Linear Circuits'*, Prentice Hall.

Reference Books:

1. F. F. Kuo,' *Network Analysis and synthesis'*, John Wiley and sons.
2. N Balabanian and T.A. Bickart, '*Linear Network Theory: Analysis, Properties, Design and Synthesis*', Matrix Publishers, Inc.
3. C. L.Wadhwa, '*Network Analysis and synthesis*', New Age international.
4. B. Somanathan Nair, "Network Analysis and Synthesis", Elsevier Publications

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ELC304	Electronic Instruments and Measurement	04	00	--	04	00	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
ELC304	Electronic Instruments and Measurement	20	20	20	80	3			100

Subject Code	Subject Name	Credits
ELC304	**Electronic Instruments and Measurement**	**04**

Prerequisite Topics*:*
System of units, Measuring Instrument.

Course Objective:
Objectives of this course are:

- In depth knowledge of measurement methods and instruments of electrical quantities.
- Understanding design aspects and performance criterion for measuring instruments.
- Implementation of the different signal generators and its analysis techniques.
- To understand the working principle of the transducers.
- To aware the students about the advances in Instrumentation.

Course Outcomes:
The outcomes of this course are**:**

- An ability to apply knowledge of electronic instrumentation for measurement of electrical quantities.
- Ability to apply the principles and practices for instrument design and development to real world problems.
- Ability to select and use latest hardware for measurements and instrumentation.
- An ability to design and conduct experiments for measurement and ability to analyze and interprets data.

Module No	Topics	Hrs.
1.	**Principles of Measurement**	06
	1.1 Introduction to Basic Instruments: Components of Generalized measurement system, applications of instrument systems, static and dynamic characteristics of instruments, Concepts of Accuracy, Precision, Linearity, Sensitivity, Resolution, Hysteresis, Calibration etc.	
	1.2 Errors in Measurement: Errors in Measurement, Classification of Errors, Remedies to Eliminate/Reduce Errors.	
2	**Test and Measuring Instruments**	10
	2.1 Analog Multi-meters: Multi-range, Multi-parameter Measurement, Electronics Voltmeter using Transistors, FETs and Opamps. Specifications of a multi-meter.	
	2.2 RLC and Q-meter: Measurement of Low, Medium and High Resistance using Wheatstone bridge, Kelvin's Double Bridge and Mega ohm Bridge; Measurement of Inductance using Maxwell Bridge and Hey Bridge; Measurement of Capacitance using Schering Bridge; Operating Principle and Applications of Q-Meter.	
	2.3 Digital Multi-meters: DMM; Automation, Auto Ranging and Auto Zero Adjustments in Digital Instruments.	
3	**Oscilloscopes**	10
	3.1 Cathode Ray Oscilloscope: Block Diagram based Study of CRO, Specifications, Controls, Sweep Modes, Role of Delay Line, Single- and Dual-Beam Dual-Trace CROs, Chop and Alternate Modes.	
	3.2 Measurement using Oscilloscope: Measurement of Voltage, Frequency, Rise Time, Fall Time and Phase Difference. Lissajous Figures in Detection of Frequency and Phase.	
	3.3 Digital Storage Oscilloscope (DSO): Features like Roll, Refresh, Storage Mode and Sampling Rate; Applications of DSO.	
4	**Transducers for Displacement and Temperature Measurement**	08
	4.1 Basics of Transducers/Sensors : Characteristics of Transducers; Requirement of Transducers; Classification of transducers; Selection Criteria of Transducers.	
	4.2 Displacement: Potentiometers; Linear Variable Differential Transformer, Resistance Strain Gauges, Capacitance Sensors.	
	4.3 Temperature: RTD, Thermisters, Thermocouples- Their Ranges, and Applications.	
5	**Transducers for Pressure, Level and Flow Measurement**	10
	5.1 Pressure: Pressure gauges; Elastic Pressure Transducers; Dead Weight Tester; Vacuum Pressure Measurement- McLeod Gauge and Pirani Gauge.	
	5.2 Level: Side glass tube method; Float type methods; Capacitance type method; Ultrasonic type transducer.	
	5.3 Flow: Restriction type Flow meters-Orifice and Venturi; Rotameter; Magnetic Flow meter; Turbine Flow meter.	
6	**Data Acquisition and advances in Instrumentation Systems**	08
	6.1 Monitoring Instruments : Indicators, Alarm, Recorders.	
	6.2 Data Acquisition and Converters: Data logger; Data acquisition system (DAS)- Single channel, Multichannel.	
	6.3 PC based Instrumentation: PC based Instrumentation System; Introduction to Programmable Logic Controller.	
	Total	**52**

Recommended Books:

1. H. Oliver and J. M. Cage, Electronic Measurement and Instrumentation, McGraw Hill, 3rd edition.
2. W. Cooper, A. Helfric, Electronic Instrumentation and Measurement Techniques, PHI, 4th edition.
3. C. S. Rangan, G.R. Sarma, V.S.V. Mani, Instrumentation Devices and Systems, Tata McGraw Hill, 9th edition.
4. A. K. Sawhney, Electrical & Electronic Instruments & Measurement, Dhanpat Rai and Sons, eleventh ed., 2000.
5. Dally, William F. Riley and Kenneth G, Instrumentation for Engineering Measurements, James John Wiley and Sons. Inc., 2nd Edition 1993.
6. A.J. Bowens, Digital Instrumentation, McGraw-Hill, latest addition.
7. J.J.Carr, Elements of Electronic Instrumentation and Control, Prentice Hall, 3rd edition.

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3: Question No.1 will be compulsory and based on entire syllabus.
4: Remaining question (Q.2 to Q.6) will be set from all the modules.
5: Weightage of marks will be as per Blueprint.

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./Tut.	Theory	Pract./Tut.	Total
ELC305	Conventional and Non-conventional Power Generation (abbreviated as CNPG)	04		04	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
ELC305	Conventional and Non-conventional Power Generation	20	20	20	80	3			100

Subject Code	Subject Name	Credits
ELC305	**Conventional and Non-conventional Power Generation (abbreviated as CNPG)**	**04**
Course Objectives	• To impart the knowledge of basics of different types of power generation & power plants in detail so that it helps them in industry oriented learning	
Course Outcomes	• Student will be familiar with techniques of power generation, operation and maintenance of power plants • Helps in understanding of impact of power solutions on the society and will be aware of contemporary issues	

Module	Contents	Hours
1	**Conventional and Non- Conventional sources of energy** Present energy scenario world wide and Indian perspective. **Economics of the power plant** Load curve, load duration curve, various factors and effects of fluctuating load on operation and methods of meeting fluctuating load. Selection of generating equipment, load sharing cost of electrical energy, basic tariff methods(numericals)	10

2	**Thermal power plant** Law of Thermodynamics. Analysis of steam cycle-Carnot, Rankine, Reheat cycle and Regenerative cycle. Layout of power plant Lay out of pulverized coal burners, fluidized bed combustion, coal handling systems, ash handling systems. Forced draught and induced draught fans, boiler feed pumps, super heater regenerators, condensers, boilers, de- aerators and cooling towers.	10
3	**Hydro power plant** Rainfall, run off and its measurement hydrograph, flow duration curve, reservoir storage capacity, classification of plants-run off river plant, storage river plant, pumped storage plant, layout of hydroelectric power plant, turbine-pelton, Kaplan, Francis(Francis)	6
4	**Nuclear power plant** Introduction of nuclear engineering, fission, fusion, nuclear material, thermal fission reactor and power plant - PWR BWR , liquid metal fast breeder, reactors, reactor control, introduction to plasma technology.	6
5	**Diesel and gas turbine power plant** General layout, Advantages and disadvantages, component, performance of gas turbine power plant, combined heat power generation.	4
6	**Power Generation using non-conventional energy sources Solar Energy** Solar concentrators and tracking ; Dish and Parabolic trough concentrating generating systems, Central tower solar thermal power plants ; Solar Ponds. Basic principle of power generation in a PV cell ; Band gap and efficiency of PV cells solar cell characteristics, Manufacturing methods of mono- and poly-crystalline cells; Amorphous silicon thin film cells. **Wind Energy** Basic component of WEC, Types of wind turbine-HAWT, VAWT, Performance parameters of wind turbine, Power in wind, Wind electric generators, wind characteristics and site selection; Wind farms for bulk power supply to grid. **Fuel Cell** Introduction to fuel cell, principle of operation of fuel cell, Types of fuel cell **Introduction to other sources** Basics of power generation by using Biomass, geothermal and tidal energy sources, MHD	12
	Total	48

Assessment:
Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Books Recommended:

Text Books:

1. MV Deshpande, *Elements of Power station design*, Tata McGraw Hill
2. DH Bacon, *Engineering Thermodynamics*, London Butterworth
3. PK Nag, *Power Plant Engineering-Steam & Nuclear*, Tata McGraw Hill

Reference Books:

1. Fredrick T Morse, *Power Plant Engineering*, East-West Press Pvt Ltd
2. Mahesh Verma, *Power Plant Engineering*, Metrolitan Book Co Pvt Ltd
3. RK Rajput, *A Text Book of Power System engineering*, Laxmi Publication
4. George W Sutton-(Editor), *Direct Energy Conversion*, Lathur University, Electronic Series Vol 3, McGraw Hill

Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ELL301	Electronic Devices and Circuits Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme					
		Theory Marks		Term Work	Practical and Oral	Oral	Total
		Internal assessment	End Sem.				
ELL301	Electronic Devices and Circuits Laboratory			25	25		50

Term Work:

At least **10** experiments covering entire syllabus of **ELC302 (Electronic Devices and Circuits)** should be set to have well predefined inference and conclusion.

The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time.** The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

List of Experiments Recommended:

1. Study of VI characteristics of standard PN junction diode, zener diode, schottkey diode.
2. Rectifier- Filter performance analysis
3. BJT biasing network stability analysis
4. Frequency response of BJT CE amplifier
5. Study of JFET characteristics and calculation of coefficients
6. Study of MOSFET characteristics and calculation of coefficients
7. Frequency response of JFET CS amplifier
8. Study of negative feedback on amplifier performance
9. Study of photo devices applications
10. Study of differential BJT amplifier
11. Study of Darlington pair amplifier
12. Study of a RC phase shift oscillator
13. Study of a Wien Bridge oscillator
14. Study of a Hartley/ Colpitts oscillator
15. Study of UJT Relaxation Oscillator

Term work:

Term work shall consist of minimum eight experiments, assignments (min two).
The distribution of marks for term work shall be as follows:
Laboratory work (Experiments)**: 10 marks**
Assignments**: 10 marks**
Attendance (Theory and Practical)**: 05 marks**
The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ELL302	Network & Measurement Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELL302	Network & Measurement Laboratory					25		25	50

Term Work:

At least **05 experiments on of ELC303 (Electrical Network) and 05 experiments on ELC304 (Electronic Instruments and Measurement)** based on the entire syllabus should be set to have well predefined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time.** The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELL303	Object Oriented Programming and Methodology	--	2+2*	--	--	02	--	02

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ELL 303	Object Oriented Programming Methodology					25	50		75

Subject Code	Subject Name	Credits
ELL303	Object Oriented Programming and Methodology	02
Course Objectives	• To understand the concept of Object Oriented Programming • To help student to understand use of programming language such as JAVA to resolve problems. • To impart problems understanding, analyzing skills in order to formulate Algorithms. • To provide knowledge about JAVA fundamentals: data types, variables, keywords and control structures. • To understand methods, arrays, inheritance, Interface, package and multithreading and concept of Applet.	

Course Outcomes	• Students will be able to code a program using JAVA constructs. • Given an algorithm a student will be able to formulate a program that correctly implements the algorithm. • Students will be able to generate different patterns and flows using control structures and use recursion in their programs. • Students will be able to use thread methods, thread exceptions and thread priority. • Students will implement method overloading in their code. • Students will be able to demonstrate reusability with the help of inheritance. • Students will be able to make more efficient programs.

Module No.	Unit No.	Topic	Hrs.
1		**Fundamental concepts of object oriented programming**	**4**
	1.1	Overview of programming	
	1.2	Introduction to the principles of object-oriented programming: classes, objects, messages, abstraction, encapsulation, inheritance, polymorphism, exception handling, and object-oriented containers	
	1.3	Differences and similarity between C++ and JAVA	
2		**Fundamental of Java programming**	**4**
	2.1	Features of Java	
	2.2	JDK Environment & tools	
	2.3	Structure of Java program	
	2.4	Keywords , data types, variables, operators, expressions	
	2.5	Decision making, looping, type casting	
	2.6	Input output using scanner class	
3		**Classes and objects**	**6**
	3.1	Creating classes and objects	
	3.2	Memory allocation for objects	
	3.3	Passing parameters to Methods	
	3.4	Returning parameters	
	3.5	Method overloading	

	3.6	Constructor and finalize ( )	
	3.7	Arrays: Creating an array	
	3.8	Types of array : One dimensional arrays ,Two Dimensional array, string	
4		**Inheritance, interface and package**	**6**
	4.1	Types of inheritance: Single, multilevel, hierarchical	
	4.2	Method overriding, super keyword, final keyword, abstract class	
	4.3	Interface	
	4.4	Packages	
5		**Multithreading**	**4**
	5.1	Life cycle of thread	
	5.2	Methods	
	5.3	Priority in multithreading	
6		**Applet**	**2**
	6.1	Applet life cycle	
	6.2	Creating applet	
	6.3	Applet tag	
		Total	**26**

Text Books:

1. Rajkumar Buyya, "*Object-oriented programming with JAVA"*, Mcgraw Hill
2. E Balgurusamy, *"Programming with JAVA",* Tata McGraw Hill

Reference Books:

1. Herbert Schildt, *"The Complete Reference JAVA",* Tata McGraw Hill
2. Barry Holmes and Daniel T. Joyce, *"Object Oriented Programming with Java",* Jones & Bartlett Learning

S. E. Electronics and Electrical Engineering - (Semester IV)

Sub Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELC401	Applied Mathematics – IV	04	--	01	04	--	01	05
ELC402	Digital Circuit and Design	04	--	--	04	--	--	04
ELC403	Electrical Machines-I	04	--	--	04	--	--	04
ELC404	Principles of Control System	04	--	--	04	--	--	04
ELC405	Fundamentals of Communication Engineering	04	--	--	04	--	--	04
ELL401	Digital Circuit and Design Laboratory	--	02	--	--	01	--	01
ELL402	Electrical Machines – I Laboratory	--	02	--	--	01	--	01
ELL403	Fundamentals of Communication Engineering Laboratory	--	02	--	--	01	--	01
ELL404	Principles of Control System Laboratory	---	02	--	--	01	--	01
Total		20	08	01	20	04	01	25

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
ELC401	Applied Mathematics – IV	20	20	20	80	3	25		125
ELC402	Digital Circuit and Design	20	20	20	80	3			100
ELC403	Electrical Machines-I	20	20	20	80	3			100
ELC404	Principles of Control System	20	20	20	80	3			100
ELC405	Fundamentals of Communication Engineering	20	20	20	80	3			100
ELL401	Digital Circuit and Design Laboratory						25	25	50
ELL402	Electrical Machines – I Laboratory						25	25	50
ELL403	Fundamentals of Communication Engineering Laboratory						25	25	50
ELL405	Principles of Control System Laboratory						25	25	50
Total				**100**	**400**		**125**	**100**	**725**

Subject Code	Subject Name	Teaching Scheme(Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELC401	Applied Mathematics - IV	04	--	01	04	--	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
ELC401	Applied Mathematics-IV	20	20	20	80	3	25		125

Subject Code	Subject Name	Credits
ELC401	**Applied Mathematics IV**	**05**
Course Objectives	This course will present the method of calculus of variations (CoV), basic concepts of vector spaces, matrix theory, concept of ROC and residue theory with applications. • To provide students with a sound foundation in mathematics and prepare them for graduate studies in Electronics and Electrical Engineering • To provide students with mathematics fundamental necessary to formulate, solve and analyze engineering problems. • To provide opportunity for students to work as part of teams on multi disciplinary projects.	
Course Outcomes	• Students will able to apply method of calculus of variations to specific systems, demonstrate ability to manipulate matrices and compute eigenvalues and eigenvectors, Identify and classify zeros, singular points, residues and their applications. • Students will demonstrate an ability to identify formulate and solve Electronics and Electrical Engineering problem using applied mathematics. • Students who can participate and succeed in competitive exams like GATE, GRE. • Students will be able to make more efficient programs.	

Module No.	Unit No.	Topics	Hrs.
1. 0		**Calculus of variation**	**10**
	1.1	Euler Langrange equation, solution of Euler's Langrange equation (only results for different cases for function) independent of a variable, independent of another variable, independent of differentiation of a variable and independent of both variables	
	1.2	Isoperimetric problems, several dependent variables	
	1.3	**Functions involving higher order derivatives:** Rayleigh-Ritz method	
2.0		**Linear algebra: vector spaces**	**12**
	2.1	**Vectors in n-dimensional vector space**: Properties, dot product, cross product, norm and distance properties in n-dimensional vector space.	
	2.2	Metric spaces, vector spaces over real field, properties of vector spaces over real field, subspaces.	
	2.3	Norms and normed vector spaces	
	2.4	Inner products and inner product spaces	
	2.5	The Cauchy-Schwarz inequality, orthogonal Subspaces, Gram-Schmidt process	
3.0		**Linear Algebra: Matrix Theory**	**15**
	3.1	Characteristic equation, Eigenvalues and Eigenvectors, properties of Eigenvalues and Eigenvectors	
	3.2	Cayley-Hamilton theorem, examples based on verification of Cayley-Hamilton theorem	
	3.3	Similarity of matrices, Diagonalisation of matrix	
	3.4	Functions of square matrix, derogatory and non-derogatory matrices	
	3.5	Quadratic forms over real field, reduction of quadratic form to a diagonal canonical form, rank, index, signature of quadratic form, Sylvester's law of inertia, value-class of a quadratic form of definite, semi- definite and indefinite	
	3.6	Singular Value Decomposition	
4.0		**Complex variables: Integration**	**15**
	4.1	**Complex Integration:** Line Integral, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula	
	4.2	Taylor's and Laurent's series	
	4.3	Zeros, singularities, poles of f(z), residues, Cauchy's Residue theorem	
	4.4	Applications of Residue theorem to evaluate real Integrals of different types	

		Total	52

Text books:

1) A Text Book of Applied Mathematics Vol. I & II by P.N.Wartilar & J.N.Wartikar, Pune, Vidyarthi Griha Prakashan., Pune
2) Mathematical Methods in science and Engineering, A Datta (2012)
3) Higher Engg. Mathematics by Dr. B.S. Grewal, Khanna Publication

Reference Books:

1) Todd K.Moon and Wynn C. Stirling, Mathematical Methods and algorithms for Signal Processing, Pearson Education.
2) Kreyszig E., Advanced Engineering Mathematics, 9th edition, John Wiley, 2006.
3) Linear Algebra- Hoffman & Kunze (Indian editions) 2002
4) Linear Algebra- Anton & Torres (2012) 9th Indian Edition.
5) Complex Analysis – Schaum Series.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered for final Internal Assessment.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Term Work/Tutorial:

At least 08 assignments covering entire syllabus must be given during the **Batch Wise Tutorial**.
The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative.
Term work assessment must be based on the overall performance of the student with every assignment graded from time to time. The grades will be converted to marks as per **Credit and Grading System** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
ELC402	Digital Circuits and Design	04	--	-	04	--	-	04

Subject Code	**Subject Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract. / oral**	**Total**
		Internal Assessment			**End Sem. Exam.**	**Exam. Duration (in Hrs)**			
		Test 1	**Test 2**	**Avg**					
ELC402	Digital Circuits and Design	20	20	20	80	3			100

Subject Code	**Subject Name**	**Credits**
ELC402	Digital Circuits and Design	**04**

Course Objectives:

1. To deliver the knowledge, motivate and train students in logic design
2. To introduce the students to various logic gates, SOP, POS and their minimization techniques.
3. To explain and describe various logic families and to provide information on different IC's.
4. To teach the working of combinational circuits and their applications.
5. To make students aware of characteristics of various types of SSI, LSI and MSI devices and their use in various applications.
6. To teach students to analyze, understand and design sequential circuits.
7. To describe State Machines and explain their design using state diagrams.
8. To explain various types of programmable devices
9. To train students in writing program with hardware description languages.
10. To prepare students for understanding courses like microprocessors, microcontrollers, VLSI design, embedded systems and digital communications

Course Outcome:

1. Ability to develop a logic and apply it to solve real life problems
2. Ability to understand current applications, trends and new directions in logic design
3. Ability to reduce SOP and POS equations.
4. Ability to understand differences between logic families TTL and CMOS
5. Ability to understand various SSI, LSI and MSI devices
6. Ability to use SSI, LSI and MSI devices in various applications

7. Ability to analyze, design and implement combinational circuits
8. Ability to analyze, design and implement sequential circuits
9. Ability to solve state machines

10. Ability to design state machines using state diagrams, State Reduction techniques and State machine synthesis using transition lists
11. Ability to understand the concept of simulation, synthesis and implementation
12. Ability to use hardware description languages for logic circuit design.
13. Ability to understand programmable logic devices
14. Ability to program CPLD and FPGA

Module No.	Topics	Hrs.
1.0	**Fundamentals of Digital Design**	**14**
1.1	**Logic Gates:** Review of basic gates, Universal gates, Sum of products and products of sum, minimization with Karnaugh Map (upto four variables) and realization.	
1.2	**Logic Families:** Types of logic families (TTL and CMOS), characteristic parameters (propagation delays, power dissipation, Noise Margin, Fan-out and Fan-in), transfer characteristics of TTL NAND, Interfacing CMOS to TTL and TTL to CMOS.	
1.3	**Combinational Circuits using basic gates as well as MSI devices:** Half adder, Full adder, Half Subtractor, Full Subtractor, multiplexer, demultiplexer, decoder, Comparator (Multiplexer and demultiplexer gate level upto 4:1). MSI devices IC7483, IC74151, IC74138, IC7485.	
2.0	**Elements of Sequential Logic Design :**	**10**
2.1	**Sequential Logic:** Latches and Flip-Flops (Conversions, timing considerations and metastability are **not** expected)	
2.2	**Counters:** Asynchronous, Synchronous Counters, Up Down Counters, Mod Counters, Ring Counters Shift Registers, Universal Shift Register	
3.0	**Sequential Logic Design:**	**10**
3.1	Mealy and Moore Machines, Clocked synchronous state machine analysis, State reduction techniques and state assignment, Clocked synchronous state machine design. (*Complex word problems like traffic light controller etc. are not expected*)	
3.2	MSI counters (7490, 74163, 74169) and applications, MSI Shift registers (74194) and their applications	
4.0	**Programmable Logic Devices:**	**07**
4.1	Concepts of PAL and PLA. Simple logic implementation using PAL and PLA. Introduction to CPLD and FPGA architectures.	
5.0	**Simulation:**	**07**
5.1	Functional Simulation, Timing simulation, Logic Synthesis, RTL	
5.2	Introduction to VHDL, Framework of VHDL Program.	
6.0	**Testability:**	**06**
6.1	Fault Models, Stuck at faults, Bridging faults, Controllability and Observability	
6.2	Path sensitization, ATPG, Design for Testability, Boundary Scan Logic, JTAG and Built in self test.	
	Total	**52**

Recommended Books

1. William I. Fletcher, 'An Engineering Approach to Digital Design', PHI.
2. B. Holdsworth and R. C. Woods, 'Digital Logic Design', Newnes, 4th Edition
3. Morris Mano, Digital Design, Pearson Education, Asia 2002.
4. John F. Wakerley, Digital Design Principles And Practices, third Edition Updated, Pearson Education, Singapore, 2002
5. Anil K. Maini, Digital Electronics, Principles, Devices and Applications, Wiley
6. Stephen Brown and Zvonko Vranesic, Fundamentals of digital logic design with VHDL, McGraw Hill, 2nd Edition.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be set from all the modules.
5. Weightage of marks will be as per Blueprint.

Subject Code	Subject Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./Tut.	Theory	Pract./Tut.	Total
ELC403	Electrical Machines- I (abbreviated as EMC-I)	4	00	4	00	4

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
ELC403	Electrical Machines –I	20	20	20	80	3			100

Subject Code	Subject Name	Credits
ELC403	**Electrical Machines- I (abbreviated as EMC-I)**	**04**
Course Objectives	• To expose the students to the concepts of DC machines, single phase transformer and their applications. • To impart industry oriented learning.	
Course Outcomes	• Students will be knowing the working principle, performance, control and applications of Electrical Machines • An ability to design and conduct performance experiments, as well as to identify, formulate and solve machine related problems.	

Module	Contents	Hours
1	**Basics of Magnetism** Magnetic field, Magnetic circuit, Numerical from series parallel magnetic circuit, Flux linkage, Inductance and energy, Faraday's laws, Hysteresis and eddy current losses.	04
2	**Electromechanical Energy Conversion** Principle, Energy stored in magnetic field, Torque in singly excited magnetic field, Reluctance motor, Doubly excited magnetic field, Torque from energy and Co- energy. Dynamic equations	08
3	**DC Machines** Construction of machine, Armature winding, Principle of operation, MMF and flux density waveforms, Significance of commutator and brushes in DC machine, EMF and Torque equation, Methods of excitations, Armature reaction, Methods to minimize the effect of armature reaction, Process of commutation, Methods to improve commutation.	10
4	**DC Motors** Characteristics of DC Motors, Concept of braking of DC separately excited motors (Rheostatic, Regenerative and plugging). Starters for shunt and series motors, Design of grading of resistance for starter, Speed Control, Losses and efficiency, Applications of DC motor.	10
5	**Testing of DC Motors** Retardation, Brake load, Swinburne, Hopkinson's, Field test.	04

6	**Transformer – Single Phase** Review of EMF equation, Equivalent Circuit and Phasor diagram of Transformer. Voltage Regulation of Transformer: - Voltage Regulation, Condition for Zero Voltage Regulation, Condition for Maximum Voltage Regulation. Transformer Losses and Efficiency - Losses, Efficiency, Condition for Maximum Efficiency, Energy Efficiency, All day Efficiency, Separation of Hysteresis and Eddy current losses Testing of Transformer: - Polarity Test, Load Test, Review of OC and SC test, Sumpner's Test, Impulse test. Autotransformer:- Autotransformer Working, Advantages of Autotransformer over Two winding Transformer, Disadvantages Parallel Operation: No load Operation, On load Operation:- Equal Voltage Operation and Unequal Voltage Operation Introduction to High Frequency Transformer, Pulse Transformer, Isolation Transformer and its applications.	12
	Total	48

Assessment:
Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Books Recommended:
Text Books:
1. Bimbhra P.S., *Electric Machinery* , Khanna Publisher,
2. Bimbhra P.S., *Generalized Machine Theory*, Khanna Publisher,
3. Kothari D.P, Nagrath I.J., *Electric Machines*, TMH Publishcations
4. A.E. Fitzgerald, Kingsly, Stephen., *Electric Machinery,* Tata McGraw Hill
5. Umanand L, Bhat S.R., "Design of Magnetic Components for Switched mode Power Converters", Wiley Eastern Ltd.

Reference Books:
1. M.G. Say and E. O. Taylor, *Direct current machines*, Pitman publication
2. Ashfaq Husain, *Electric Machines*, Dhanpat Rai and co. publications
3. M.V. Deshpande, *Electric Machines*, PHI
4. Smarajit Ghosh, *Electric Machines*, PEARSON

Term work:
Term work shall consist of minimum eight experiments, assignments (min two)
The distribution of marks for term work shall be as follows:
Laboratory work (Experiments) **: 10 marks**
Assignments : **10 marks**

Attendance (Theory and Practical) **: 05 marks**
The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ELC 404	Principles of Control System	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. / oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
ELC404	Principles of Control System	20	20	20	80	3			100

Subject Code	Subject Name	Credits
ELC404	Principles of Control Systems	**04**

Prerequisite Topics*:*
Differential equations; Laplace transforms and Matrices.

Course Objectives:
Objectives of this course are:
1. To study the fundamental concepts of Control systems and mathematical modeling of the system.
2. To study the concept of time response and frequency response of the system.
3. To study the basics of stability analysis of the system and design of simple controllers

Course Outcome:
1. Students will be able to derive the mathematical model of different type of the systems.
2. Students will understand the basic concepts of control system.
3. Students will understand the analysis of systems in time and frequency domain.
4. Students will be able to apply the control theory to design the conventional PID controller widely used in the industries.

Module No.	Topics	Hrs.
1.	**Introduction to control system analysis**	06
	1.1 Introduction: Open loop and closed loop systems; feedback and feedforward control structure; examples of control systems.	
	1.2 Modeling: Types of models; Impulse response model; State variable model; Transfer function model.	
	1.3 Dynamic Response: Standard test signals; Transient and steady state behavior of first and second order systems; Steady state errors in feedback control systems and their types.	
2	**Mathematical modeling of systems**	08
	2.1 Transfer function models of various systems: Models of mechanical systems; Models of electrical systems; Models of thermal systems.	
	2.2 Manipulations: Block diagram reduction; Signal flow graph and the Mason's gain rule.	
	State Variable Models	

3	**3.1 State variable models of various systems:** State variable models of mechanical systems; State variable models of electrical systems; State variable models of thermal systems.	12
	3.2 State transition equation: Concept of state transition matrix; Properties of state transition matrix; Solution of homogeneous systems; solution of non-homogeneous systems.	
	3.3 Controllability and observability: Concept of controllability; Controllability analysis of LTI systems; Concept of observability; Observability analysis of LTI systems using Kalman approach.	
4	**Stability analysis in time domain**	06
	4.1 Concepts of Stability: Concept of absolute, relative and robust stability; Routh stability criterion.	
	4.2 Root locus analysis: Root-locus concepts; General rules for constructing root-locus; Root-locus analysis of control systems.	
5	**Stability analysis in frequency domain**	10
	5.1 Introduction: Frequency domain specifications, Response peak and peak resonating frequency; Relationship between time and frequency domain specification of system; Stability margins.	
	5.2 Bode plot: Magnitude and phase plot; Method of plotting Bode plot; Stability margins on the Bode plots; Stability analysis using Bode plot.	
	5.3 Nyquist Criterion: Polar plots, Nyquist stability criterions; Nyquist plot; Gain and phase margins.	
6	**Compensators and controllers**	10
	6.1 Compensators: Types of compensation; Need of compensation; Lag compensator; Lead compensator.	
	6.2 Controllers: Concept of ON/OFF controllers; Concept of P, PI, PD and PID Controllers.	
	6.3 Advances in Control Systems: Introduction to Robust Control, Adaptive control and Model predictive control.	
	Total	**52**

Recommended Books

1. I. J. Nagrath, M. Gopal, Control Systems Engineering, New Age International, Fifth Edition, 2012.
2. Dhanesh N. Manik, Control Systems, Cengage Learning, First Edition, 2012.
3. M. Gopal, Control Systems: Principle and design, Tata McGraw Hill, First Edition, 1998
4. Richard C. Dorf and Robert H. Bishop, Modern Control System, Pearson, Eleventh Edition, 2013.
5. Norman S. Nice, Control Systems Engineering, John Wiley and Sons, Fifth Edition, 2010
6. Rajeev Gupta, Control Systems Engineering, Wiley India, First Edition, 2011.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- The students need to solve total 4 questions.
- Question No.1 will be compulsory and based on entire syllabus.
- Remaining question (Q.2 to Q.6) will be set from all the modules.
- Weightage of marks will be as per Blueprint.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELC 406	Fundamentals of Communication Engineering	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical And Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELC 406	Fundamentals of Communication Engineering	20	20	20	80				100

Prerequisite Topics*:* Basic Electronic Devices and Circuits and measurements

Course Objective:

1. To understand basics of wireless communication systems.
2. To understand modulation and demodulation techniques.
3. To understand working of transmitters and receivers
4. To understand the basic concept of Digital communication

Course Outcome:

1. Students will be able to understand the components of wireless communication systems
2. Students will be able to understand various modulation techniques and their applications
3. Students will be able to understand difference between analog and digital communication

Module No.	Unit No.	Topics	Hrs.
1.0		**Elements of Communication System :**	**08**
	1.1	**Electromagnetic Waves Propagation:** Maxwell's equations for static and time varying fields, wave equation for free space and dielectric mediums, propagation terms and definition, electromagnetic frequency spectrum,	
	1.2	**Basic communication system:** Block diagram representation	
	1.3	**Concept of Modulation and Demodulation:** Signal representation**, n**oise in communication signals and channels, signal-to-noise ratio, noise factor and noise figure, equivalent noise temperature	
2.0		**Amplitude Modulation**	**10**
	2.1	Principles of DSB Full Carrier AM	
	2.2	**Different types of AM :** DSB-SC ,SSB-SC , VSB, ISB	
	2.3	Practical diode detector	
3.0		**Angle modulation**	**10**
	3.1	Principles of Frequency Modulation and Phase Modulation	
	3.2	**FM Modulators:** Narrow band FM and wide band FM, FM transmitter, noise triangle, Pre-emphasis and De-emphasis circuits	
	3.3	**FM Detection**: frequency discriminator and phase discriminator	
4.0		**Radio Receivers**	**06**
	4.1	Receiver Characteristics , TRF Receivers, and Super heterodyne, Receivers, Choice of IF, AGC, AFC in AM and FM receivers	
5.0		**Analog Pulse Modulation**	**08**
	5.1	**Sampling:** Theorem, aliasing error and sampling techniques	
	5.2	Demodulation and spectrum of PAM, PWM, PPM	
6.0		**Digital Pulse Modulation(only concepts and no numerical problems)**	**10**
	6.1	Comparison of digital signal transmission and analog signal transmission	
	6.2	Pulse- code modulation (PCM) : sampling ,quantizing ,encoding technique, PCM bandwidth	
	6.3	Concept of Delta modulation (DM) and Adaptive Delta Modulation(ADM)	
	6.4	Multiplexing: TDM, FDM- Principles & applications	
		Total	**52**

Recommended Books:

1. Wayne Tomasi "*Electronics communication systems*" Pearson education, Third edition, 2001.
2. Kennedy and Davis "*Electronics communication system* ",Tata McGraw Hill
3. R.P. Sing and S.D. Sapre, "*Communication systems Analog and Digital*", Tata McGraw Hill
4. Taub and Schilling "*Principles of communication systems*", Tata McGraw Hill
5. Roy Blake, "*Electronics communication system*", Thomson learning, second edition.
6. B.P. Lathi "*Modern Digital and analog Communication system*" Third edition, OXFORD
7. Robert J. Schoenbeck "*Electronics communications modulation and transmission*".
8. Lean W couch "*Digital and Analog communication system*", Pearson education, Sixth edition.
9. Roddy Coolen, "*Electronic Communications*" PHI

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.
5. Weightage of marks will be as per Blueprint.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ELL401	Digital Circuits and Design Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme					
		Theory Marks		Term Work	Practical and Oral	Oral	Total
		Internal assessment	End Sem.				
ELL401	Digital Circuits and Design Laboratory			25	25		50

Term Work:
At least **10** experiments covering entire syllabus of **ELC402 (Digital Circuits and Design)** should be set to have well predefined inference and conclusion. Computation/simulation based experiments are encouraged.
Therefore, 5 simulation experiments be carried out (out of total 10 Expts.). The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time.** The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested Experiments:

1. SOP and POS Minimization (different problem statement for each student)
2. Characteristics of TTL and MOS logic family
3. Implementation of combinational circuits using MSI devices. (at least two)
4. Implementation of counters with flip-flops (at least one synchronous and one asynchronous)
5. Implementation of sequential circuits using MSI devices. (at least two)
6. Implementation of FSM (different problem statement for each student)
7. VHDL based simulations (Instructor should teach syntax and give different program to each student for simulation. Minimum Four programs covering behavioral, structural and dataflow modeling)
8. Verilog/VHDL based simulations (Instructor should teach syntax and give different program to each student for simulation. Minimum Four programs covering behavioral, structural, dataflow and switch level modeling)
9. Synthesis, downloading and Verification on CPLD and FPGA (for both VHDL and Verilog programs)
10. Troubleshooting of given fault (teacher should generate set of faults in different circuits and ask students to troubleshoot)

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ELL402	Electrical Machines-I Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme					
		Theory Marks		Term Work	Practical and Oral	Oral	Total
		Internal assessment	End Sem.				
ELL402	Electrical Machines-I Laboratory	--	--	25	25		50

Term Work:
At least **10** experiments covering entire syllabus of **ELC403 (Electrical Machines-I)** should be set to have well predefined inference and conclusion.
The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time.** The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

List of Experiments Recommended:
1) O.C.C of Separately excited DC generator
2) Load Test on DC Shunt Motor
3) Load Test on DC SeriesMotor
4) Load Test on DC Compound Motor
5) Speed Control of DC shunt Motor (Armature and Field Control)
6) Swinburne's Test
7) Hopkinson's Test
8) Field's Test
9) O.C & S.C. Test on 1Φ Transformer
10) Sumpner's Test on 1Φ Transformer
11) Separation of iron loss into hysteresis and eddy current loss components in a1Φ Transformer
12) Load Test on 1Φ Transformer
13) Parallel operation of 1Φ Transformer

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ELL403	Fundamentals of Communication Engineering Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELL403	Fundamentals of Communication Engineering Laboratory					25		25	50

Term Work:
At least 10 experiments based on entire syllabus of **ELC405 (Fundamentals of Communication Engineering)** should be set to have well predefined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time.** The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ELL404	Principles of Control System Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ELL404	Principles of Control System Laboratory					25		25	50

Term Work:
At least 10 experiments based on entire syllabus of **ELC404 (Principles of Control System)** should be set to have well predefined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the **overall performance** of the student with **every experiment graded from time to time.** The grades should be converted into marks as per the **Credit and Grading System** manual and should be **added and averaged**. The grading and term work assessment should be done based on this scheme.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

T. E. Electronics and Electrical Engineering - (Semester V)

Sub Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELC501	Microprocessors & Peripherals	04	--	--	04	--	--	04
ELC502	Electrical Machines –II	04	--	--	04	--	--	04
ELC503	Electromagnetic Fields & Waves	04	--	01	04	--	01	05
ELC504	Design with Linear Integrated Circuits	04	--	--	04	--	--	04
ELC505	Elements of Power System	04	--	01	04	--	01	05
ELS506	Business Communication & Ethics	--	04*	--	--	02	--	02
ELL501	Microprocessors & Peripherals Laboratory	--	02	--	--	01	--	01
ELL502	Electrical Machines –II Laboratory	--	02	--	--	01	--	01
ELL503	Design with Linear Integrated Circuits Laboratory	--	02	--	--	01	--	01
ELL504	Mini Project - I	--	02	--	--	02	--	02
Total		20	12	02	20	07	02	29

*2 Hours to be conducted class wise and the remaining 2 hours to be conducted batch wise

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
ELC501	Microprocessors & Peripherals	20	20	20	80	3			100
ELC502	Electrical Machines –II	20	20	20	80	3			100
ELC503	Electromagnetic Fields & Waves	20	20	20	80	3	25		125
ELC504	Design with Linear Integrated Circuits	20	20	20	80	3			100
ELC505	Elements of Power System	20	20	20	80	3	25		125
ELS506	Business Communication & Ethics						50		50
ELL501	Microprocessors & Peripherals Laboratory						25		25
ELL502	Electrical Machines –II Laboratory						25	25	50
ELL503	Design with Linear Integrated Circuits Laboratory						25	25	50
ELL504	Mini Project - I						25	25	50
Total				**100**	**400**		**200**	**75**	**775**

***Common to all branches, 02 Hrs. Class wise and 02 Hrs. Batch wise # Class wise**

T. E. Electronics and Electrical Engineering - (Semester VI)

Sub Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELC601	Microcontroller & its Application	04	--	--	04	--	--	04
ELC602	Electrical Machines –III	04	--	--	04	--	--	04
ELC603	Power Electronics	04	--	--	04	--	--	04
ELC604	Power System Analysis	04	--	--	04	--	--	04
ELC605	Signals & System	04	--	--	04	--	--	04
ELC606	Project Management	02	--	--	02	--	--	02
ELL601	Microcontroller & its Application Laboratory	--	02	--	--	01	--	01
ELL602	Electrical Machines –III Laboratory	--	02	--	--	01	--	01
ELL603	Power Electronics & Power System Analysis Laboratory	--	02	--	--	01	--	01
ELL604	Digital Signal Processing & Processors Laboratory	--	02	--	--	01	--	01
ELL605	Mini-Project-II	--	02	--	--	02	--	02
Total		22	10	--	22	06	--	28

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
ELC601	Microcontroller & its Application	20	20	20	80	3			100
ELC602	Electrical Machines –III	20	20	20	80	3			100
ELC603	Power Electronics	20	20	20	80	3			100
ELC604	Power System Analysis	20	20	20	80	3			100
ELC605	Signals & System	20	20	20	80	3			100
ELC606	Project Management	10	10	10	40	3			50
ELL601	Microcontroller & its Application Laboratory						25	25	50
ELL602	Electrical Machines –III Laboratory						25	25	50
ELL603	Power Electronics & Power System Analysis Laboratory						25	25	50
ELL604	Digital Signal Processing & Processors Laboratory						25		25
ELL605	Mini-Project-II						25	25	50
Total				**110**	**440**		**125**	**100**	**775**

B. E. Electronics and Electrical Engineering - (Semester VII)

Sub Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELC701	Drives & Control	04	--	--	04	--	--	04
ELC702	Embedded System & Real Time Programming	04	--	--	04	--	--	04
ELC703	Basics of VLSI Design	04	--	--	04	--	--	04
ELC704	Power System Operation & Control	04	--	--	04	--	--	04
ELE70X	Elective-I	04	--	--	04	--	--	04
ELL701	Drives & Control Laboratory	--	02	--	--	01	--	01
ELL702	Embedded System & Real Time Programming Laboratory	--	02	--	--	01	--	01
ELL703	Basics of VLSI Design Laboratory	--	02	--	--	01	--	01
ELL704	Power System Operation & Control Laboratory	--	02	--	--	01	--	01
ELP701	Project-I	--	06	--	--	03	--	03
Total		20	14	--	20	07	--	27

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract. /oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
ELC701	Drives & Control	20	20	20	80	3			100
ELC702	Embedded System & Real Time Programming	20	20	20	80	3			100
ELC703	Basics of VLSI Design	20	20	20	80	3			100
ELC704	Power System Operation & Control	20	20	20	80	3			100
ELE70X	Elective-I	20	20	20	80	3			100
ELL701	Drives & Control Laboratory						25	25	50
ELL702	Embedded System & Real Time Programming Laboratory						25	25	50
ELL703	Basics of VLSI Design Laboratory						25	25	50
ELL704	Power System Operation & Control Laboratory						25		25
ELP701	Project-I						25	25	50
Total				**100**	**400**		**125**	**100**	**725**

B. E. Electronics and Electrical Engineering - (Semester VIII)

Sub Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELC801	Digital Image Processing	04	--	--	04	--	--	04
ELC802	Industrial Automation	04	--	--	04	--	--	04
ELC803	High Voltage DC Transmission	04	--	--	04	--	--	04
ELE80X	Elective- II	04	--	--	04	--	--	04
ELL801	Digital Image Processing Laboratory	--	02	--	--	01	--	01
ELL802	Industrial Automation Laboratory	--	02	--	--	01	--	01
ELL803	High Voltage DC Transmission Laboratory	--	02	--	--	01	--	01
ELL804	Elective- II Laboratory	--	02	--	--	01	--	01
ELP801	Project-II	--	12	--	--	06	--	06
Total		16	20	--	16	10	--	26

Subject Code	**Subject Name**	**Examination Scheme**							
		Theory					**Term Work**	**Pract. /oral**	**Total**
		Internal Assessment			**End Sem.**	**Exam. Duration**			
		Test1	**Test 2**	**Avg.**					

					Exam.	(in Hrs)			
ELC801	Digital Image Processing	20	20	20	80	3			100
ELC802	Industrial Automation	20	20	20	80	3			100
ELC803	High Voltage DC Transmission	20	20	20	80	3			100
ELE80X	Elective- II	20	20	20	80	3			100
ELL801	Digital Image Processing Laboratory						25	25	50
ELL802	Industrial Automation Laboratory						25	25	50
ELL803	High Voltage DC Transmission Laboratory						25	25	50
ELL804	Elective- II Laboratory						25	25	50
ELP801	Project-II						50	50	100
Total				**80**	**320**		**150**	**150**	**700**

Subject Code	**Elective - I**	**Subject Code**	Elective – II
ELE701	Protection & Switch Gear Engineering	ELE801	Advanced Control System
ELE702	Renewable Energy & Energy Storage Systems	ELE802	Power Quality
ELE703	Artificial Neural Network	ELE803	Analog & Mixed Signal VLSI
ELE704	Optical Fibre Communication	ELE804	Robotics
ELE 705	Digital Signal Processing & Processors		