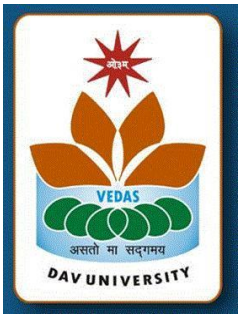
DAV UNIVERSITY
JALANDHAR



Course Scheme & Syllabus

For

B. Tech. in Electrical Engineering

1st TO 8th SEMESTER
Examinations 2022–2026 Session

Syllabi Applicable For Admissions in 2022

Mandatory Induction program (Appendix A)

[Induction program for students to be offered right at the start of the first year.]

3 Weeks Induction Program(Mandatory)
• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to Local Areas • Familiarization to Dept./Branch & Innovations

Scheme of Courses
B. Tech. in Electrical Engineering
Semester-1

S.No	PAPERCODE	COURSE TITLE	L	T	P	CR	NATURE OF COURSE
1	MTH151A	ENGINEERING MATHEMATICS-I	4	0	0	4	CORE
2	ELE105	BASIC ELECTRICAL ENGINEERING	4	0	0	4	CORE
3	MEC103	MECHANICAL ENGINEERING FUNDAMENTALS	4	0	0	4	CORE
4	MEC104	MANUFACTURING PRACTICE	0	0	4	2	AECC
5	PHY151B	ENGINEERING PHYSICS	4	0	0	4	CORE
6	PHY152	ENGINEERING PHYSICS LAB	0	0	2	1	CORE
7	SGS107B	HUMAN VALUES AND GENERAL STUDIES	4	0	0	0	NON CREDIT
8	ELE106	BASIC ELECTRICAL ENGINEERING LABORATORY	0	0	2	1	CORE
TOTAL			20	0	8	20	

L: Lectures T: Tutorial P: Practical Cr: Credits

Scheme of Courses
B. Tech. in Electrical Engineering
Semester-2

S.No	PAPER CODE	COURSE TITLE	L	T	P	CR	NATURE OF COURSE
1	MTH152A	ENGINEERING MATHEMATICS-II	4	0	0	4	CORE
2	CHE151A	CHEMISTRY	4	0	0	4	CORE
3	CSE101A	COMPUTER FUNDAMENTALS AND PROGRAMMING	4	0	0	4	CORE
4	ENG151A	BASIC COMMUNICATION SKILLS	3	0	0	3	AECC
5	EVS100A	ENVIRONMENTAL STUDIES	4	0	0	0	NON-CREDIT
6	MEC101A	ENGINEERING DRAWING	2	0	4	4	CORE
7	CHE152	CHEMISTRY LAB	0	0	2	1	CORE
8	CSE103	COMPUTER FUNDAMENTALS AND PROGRAMMING LAB	0	0	2	1	CORE
9	ENG152	BASIC COMMUNICATION SKILLS LABORATORY	0	0	2	1	AECC
TOTAL			21	0	10	21	

L: Lectures T: Tutorial P: Practical Cr: Credits

Note: *At the end of the examination of 2nd Semester the students will undergo compulsory Swachh Bharat Summer Internshipfor a period of 100Hours duration. The credits for this will be included in the 3rd semester.*
Visit to nearby power plant Hydro, Thermal, Nuclear.

Scheme of Courses
B. Tech. in Electrical Engineering
Semester-3

Sr. No	COURSE CODE	COURSE TITLE	L	T	P	CR	NATURE OF COURSE
1.	ELE201A	NETWORK ANALYSIS & SYNTHESIS	4	0	0	4	CORE
2.	ELE202A	ELECTRICAL MACHINES-I (DC MACHINES & TRANSFORMERS)	4	0	0	4	CORE
3.	ELE209A	ELECTRICAL MEASUREMENT AND INSTRUMENTATION	4	0	0	4	CORE
4.	MTH252A	ENGINEERING MATHEMATICS-III	4	0	0	4	CORE
5.	ELE216	GENERATION & CONTROL OF POWER	4	0	0	4	CORE
6.	ELE203A	DC MACHINE & TRANSFORMERS LABORATORY	0	0	2	1	CORE
7.	ELE210	ELECTRICAL MEASUREMENT AND INSTRUMENTATION LABORATORY	0	0	2	1	CORE
8.	ELE400	SWACHH BHARAT SUMMER INTERNSHIP	0	0	0	2	AECC
TOTAL			20	0	4	24	

L: Lectures T: Tutorial P: Practical Cr: Credits

Scheme of Courses
B. Tech. in Electrical Engineering
Semester-4

Sr. No	COURSE CODE	COURSE TITLE	L	T	P	CR.	NATURE OF COURSE
1.	ECE211	ANALOG ELECTRONICS	4	0	0	4	CORE
2.	ELE204	ELECTROMAGNETIC FIELD THEORY	4	0	0	4	CORE
3.	ELE218	ELECTRICAL MACHINES –II (ASYNCHRONOUS & SPECIAL PURPOSE MACHINES)	4	0	0	4	CORE
4.	ELE217A	POWER SYSTEM-I (TRANSMISSION & DISTRIBUTION)	4	0	0	4	CORE
5.	ELE214B	RENEWABLE ENERGY SOURCES AND MANAGEMENT	3	0	0	3	CORE
6.	ECE214	ANALOG ELECTRONICS LABORATORY	0	0	2	1	CORE
7.	ELE470A	ESTIMATION AND COSTING LABORATORY	0	0	6	3	CORE
TOTAL			19	0	8	23	

L: Lectures T: Tutorial P: Practical Cr: Credits

Note: *At the end of the examination of 4thSemester the students will undergo compulsory industrial trainingfor a period of 4 weeks duration in reputed industries. Every student will submit the Training Report within two weeks from the start of teaching for 5th Semester. The credit for this will be included in the 5th Semester.*

Scheme of Courses
B. Tech. in Electrical Engineering
Semester-5

SR. No.	COURSE CODE	COURSE TITLE	L	T	P	CR.	NATURE OF COURSE
1.	ELE330	SIGNAL AND SYSTEMS	3	0	0	3	CORE
2.	ELE306A	POWER ELECTRONICS	4	0	0	4	CORE
3.	ELE 310	POWER ELECTRONICS LABORATORY	0	0	2	1	CORE
4.	ELE314	DIGITAL ELECTRONICS	3	0	0	3	CORE
5.	ELE342A	POWER SYSTEM-II (STABILITY & FAULT ANALYSIS)	4	0	0	4	CORE
6.	ELE318A	TRANSDUCER AND SIGNAL CONDITIONING	3	0	0	3	CORE
7.	ELE331	DIGITAL ELECTRONICS LABORATORY	0	0	2	1	CORE
8.	ELE350	INDUSTRIAL TRAINING-I	0	0	0	2	TRAINING, SEMINAR AND PROJECT
9.	ELE317	DESIGN AND SOFTWARE LABORATORY	1	0	3	2	CORE
TOTAL			18	0	7	23	

L: Lectures T: Tutorial P: Practical Cr: Credits

Scheme of Courses
B. Tech. in Electrical Engineering
Semester-6

SR. NO.	COURSE CODE	COURSE TITLE	L	T	P	CR.	NATURE OF COURSE
1.	ELE337	POWER SYSTEM –III (SWITCHGEAR & PROTECTION)	4	0	0	4	CORE
2.	ELE338	CONTROL SYSTEM	4	0	0	4	CORE
3.	ELE339	CONTROL SYSTEM LABORATORY	0	0	2	1	CORE
4.	ELE343	ELECTRICAL SAFETY AND STANDARDS	3	0	0	3	CORE
5.	ENG351	TECHNICAL COMMUNICATION	3	0	0	3	AECC
6.	ELE340	ELECTRICAL MACHINES – III (SYNCHRONOUS MACHINES)	4	0	0	4	CORE
7.	ELE33X	DISCIPLINE SPECIFIC ELECTIVE-I	4	0	0	4	DSE I
8.	ELE309	POWER SYSTEM LABORATORY	0	0	2	1	CORE
9.	ELE341	ASYNCHRONOUS & SYNCHRONOUS MACHINES LABORATORY	0	0	2	1	CORE
TOTAL			22	0	6	25	

L: Lectures T: Tutorial P: Practical Cr: Credits

Note:

- *Discipline specific elective-I should be from the basket of "Discipline Specific Elective-I".*
- *At the end of the examination of 6thSemester the students will undergo compulsory industrial training for a period of 6 weeks duration in reputed industries. Every student will submit the*

training report within two weeks from the start of teaching of 7th Semester. The credits for this will be included in the 7th semester.

Scheme of Courses
B. Tech. in Electrical Engineering
Semester-7

SR. No	COURSE CODE	COURSE TITLE	L	T	P	CR.	NATURE OF COURSE
1.	ELE410	MICROPROCESSOR & MICROCONTROLLER	4	0	0	4	CORE
2.	ELE411	MICROPROCESSOR, MICROCONTROLLER & PLC LABORATORY	0	0	2	1	CORE
3.	ELE326	ELECTRIC DRIVES	4	0	0	4	CORE
4.	ELEXXX	DISCIPLINE SPECIFIC ELECTIVE –II	4	0	0	4	DSE-II
5.	ELEXXX	DISCIPLINE SPECIFIC ELECTIVE –III	4	0	0	4	DSE-III
6.		GENERIC ELECTIVE - I	4	0	0	4	GENERIC ELECTIVE -I
7.	ELE406A	INDUSTRIAL TRAINING-II	0	0	0	2	TRAINING, SEMINAR AND PROJECT
8.	ELE451A	PROJECT LABORATORY	0	0	8	4	TRAINING, SEMINAR AND PROJECT
TOTAL			20	0	10	27	

L: Lectures T: Tutorial P: Practical Cr: Credits

Note:

- *Discipline specificelective-II should be from the basket of "Discipline Specific Elective-II".*
- *Generic elective-I should be from the "Generic Elective Basket"*

Scheme of Courses
B. Tech. in Electrical Engineering
Semester-8

SR. NO.	COURSE CODE	COURSE TITLE	L	T	P	CR.	NATURE OF COURSE
1.	ELEXXX	DISCIPLINE SPECIFIC ELECTIVE – IV	4	0	0	4	DSE-IV
2.	ELEXXX	DISCIPLINE SPECIFIC ELECTIVE - V	4	0	0	4	DSE-V
3.	ELE477	HIGH VOLTAGE ENGINEERING	4	0	0	4	CORE
4.	ELE412	UTILIZATION & TRACTION	4	0	0	4	CORE
5.		GENERIC ELECTIVE - II	4	0	0	4	GENERIC ELECTIVE -II
6.	ELE452	SEMINAR	0	0	4	2	TRAINING, SEMINAR AND PROJECT
TOTAL			20	0	4	22	

L: Lectures T: Tutorial P: Practical Cr: Credits

Note:

- *Discipline specificelective-III & IV should be from the basket of "Discipline Specific Elective-III & IV" respectively.*

- *Generic elective-II should be from the "Generic Elective Basket"*

Discipline Specific Elective-I

Sr. No.	Course Code	Course Title	L	T	P	Credit
1	ELE327	ELECTRICAL MACHINE DESIGN	4	0	0	4
2	ELE332	ENERGY EFFICIENT MACHINES	4	0	0	4
3	ELE333	BIOMEDICAL ENGINEERING	4	0	0	4
4	ELE334	INDUSTRIAL PROCESS CONTROL	4	0	0	4
5	ELE335	COMMUNICATION SYSTEMS	4	0	0	4
		MOOC-I Courses	4	0	0	4
Discipline Specific Elective-II						
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	ELE431	RELIABILITY ENGINEERING	4	0	0	4
2	ELEXXX	INDUSTRIAL ROBOTICS	4	0	0	4
3	ELE447	DIGITAL CONT4ROL SYSTEMS	4	0	0	4
4	ELE439	MICROSENSORS AND SMART DEVICES	4	0	0	4
5	ELE437	DIGITAL SIGNAL PROCESSING	4	0	0	4
		MOOC-II Courses	4	0	0	4
Discipline Specific Elective-III						
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	ELE448	OPTIMAL CONTROL	4	0	0	4
2	ELE436	FUNDAMENTALS OF VIRTUAL INSTRUMENTATION	4	0	0	4
3	ELE449	COMPUTATIONAL ELECTROMAGNETICS	4	0	0	4
4	ELE450	ELECTRICAL ENGINEERING MATERIALS	4	0	0	4
5	ELE468	ADVANCED INSTRUMENTATION	4	0	0	4
		MOOC-III Courses	4	0	0	4
Discipline Specific Elective-IV						
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	ELE459	ELECTRICAL AND HYBRID VEHICLES	4	0	0	4
2	ELE460	NEURAL NETWORKS AND FUZZY LOGICS	4	0	0	4
3	ELE408	ELECTRICAL ENERGY AUDITING AND DEREGULATION	4	0	0	4
4	ELE461	POWER QUALITY AND FACTS	4	0	0	4
5	ELE435	OPTIMIZATION TECHNIQUES	4	0	0	4
		MOOC-IV Courses	4	0	0	4
Discipline Specific Elective-V						
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	ELE463	POWER SYSTEM DYNAMICS AND CONTROL	4	0	0	4
2	ELE464	INDUSTRIAL ELECTRICAL SYSTEMS	4	0	0	4
3	ELE465	ADVANCED ELECTRIC DRIVES	4	0	0	4
4	ELE467	CONTROL SYSTEMS DESIGN	4	0	0	4
5	ELE407	POWER PLANT ENGINEERNING	4	0	0	4

		MOOC-V Courses	4	0	0	4

List of MOOC courses

Students have been given the choices for the MOOC/Elective courses. The proposed list of MOOC courses have been given, however the student have choice to choose relevant courses with due consent of department head that must be running in particular academic semester.

MOOC-I						
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	MOOC	POWER QUALITY	4	0	0	4
2	MOOC	SIGNAL PROCESSING FOR MMWAVE COMMUNICATION FOR 5G AND BEYOND	4	0	0	4
3	MOOC	CONTROL AND TUNING METHODS IN SWITCHED MODE POWER CONVERTERS	4	0	0	4
4	MOOC	ADVANCED MICROWAVE GUIDED-STRUCTURES AND ANALYSIS	4	0	0	4
MOOC COURSES -II						
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	MOOC	INTRODUCTION TO SEMICONDUCTOR DEVICES	4	0	0	4
2	MOOC	MATHEMATICAL ASPECTS OF BIOMEDICAL ELECTRONIC SYSTEM DESIGN	4	0	0	4
3	MOOC	DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS	4	0	0	4
4	MOOC	COMPUTER VISION AND IMAGE PROCESSING FUNDAMENTALS AND APPLICATIONS	4	0	0	4
MOOC COURSES -III						
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	MOOC	INTRODUCTION TO TIME-VARYING ELECTRICAL NETWORKS	4	0	0	4
2	MOOC	DIGITAL SYSTEM DESIGN	4	0	0	4
3	MOOC	PHOTONIC INTEGRATED CIRCUIT	4	0	0	4
4	MOOC	APPLIED LINEAR ALGEBRA	4	0	0	4
MOOC COURSES -IV						
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	MOOC Courses	POWER SYSTEM PROTECTION	4	0	0	4
2	MOOC	FIBER OPTIC COMMUNICATION TECHNOLOGY	4	0	0	4
3	MOOC	IMAGE SIGNAL PROCESSING	4	0	0	4
4	MOOC	INTRODUCTORY NEUROSCIENCE & NEURO-INSTRUMENTATION	4	0	0	4
MOOC COURSES -V						
Sr. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
1	MOOC	INFORMATION THEORY	4	0	0	4
2	MOOC	HIGH POWER MULTILEVEL CONVERTERSANALYSIS, DESIGN AND OPERATIONAL ISSUES	4	0	0	4
3	MOOC	MICROPROCESSORS AND INTERFACING	4	0	0	4
4	MOOC	STATISTICAL SIGNAL PROCESSING	4	0	0	4

Generic Elective Basket

S.NO.	PAPER CODE	COURSE TITLE	L	T	P	Cr
1	ELE801	ELECTRO-MECHANICAL ENERGY CONVERSION	4	0	0	4
2	ELE802	TRANSDUCERS AND SIGNAL CONDITIONING	4	0	0	4
3	ELE 803	FUNDAMENTALS OF ELECTRICAL MEASUREMENT AND INSTRUMENTATION	4	0	0	4
4	CHL801	INDUSTRIAL POLLUTION CONTROL	4	0	0	4
5	CHL802	FUEL CELL TECHNOLOGY	4	0	0	4
6	MEC801	INDUSTRIAL ENGINEERING TECHNIQUES	4	0	0	4
7	MEC802	ENERGY RESOURCES	4	0	0	4
8	CSE801	SOFTWARE ENGINEERING & PROJECT MANAGEMENT	4	0	0	4
9	CSE802	COMPUTER NETWORKS	4	0	0	4
10	ECE801	COMMUNICATION AND MEDIA FOUNDATIONS	4	0	0	4
11	ECE802	ELECTRONIC DISPLAYS	4	0	0	4
12	ECE803	EVERYDAY ELECTRONICS	4	0	0	4
13	CIV801	CONSTRUCTION MATERIALS AND TECHNIQUES	4	0	0	4
14	CIV802	RAILWAY AND TUNNEL ENGINEERING	4	0	0	4
15	MGT151A	FUNDAMENTALS OF MANAGEMENT	4	0	0	4
16	MGT152	FUNDAMENTALS OF ADVERTISING	4	0	0	4
17	MGT153	FUNDAMENTALS OF STOCK MARKET	4	0	0	4
18	MGT154	FUNDAMENTALS OF RESEARCH METHODS	4	0	0	4
19	MGT155	FUNDAMENTALS OF ACCOUNTING & FINANCE	4	0	0	4

B Tech Course Structure

CBCS	Nature of Courses	Core	Elective Courses			Ability Enhancement Courses		Total Credits
Year	Course Structure	Core	TRAINING, SEMINAR AND PROJECT	Generic Elective	Discipline Specific Elective/ MOOC Courses	Ability Enhancement Compulsory Courses	Skill Enhancement Courses	
2020	Electrical	137	10	8	20	11	8*	186+8* =186

Core	=	137
Dissertation/ Project	=	10
Generic Elective	=	8
Discipline Specific Elective	=	20
Ability Enhancement Compulsory Courses	=	6
Skill Enhancement Courses (Non-Credit course)	=	8*

Detailed Syllabus

Course Title:	Engineering Mathematics-I		L	T	P	Cr
Course Code:	MTH151A		4	0	0	4
Course Outcome: After completion of course, the students should be able to	**CO1**	**Understanding** Rank of matrices,				
	CO2	Concept of limit and continuity of a function of two variables				
	CO3	**Solution of differential equation** by separation of variables				
	CO4	Solution of differential equations with constant coefficients:				
	CO5	Simultaneously Linear differential equation and its solution				

Unit A	Rank of matrices, Inverse of Matrices, Gauss Jordan Method, reduction to normal form, Consistency and solution of linear algebraic system of equations, Gauss Elimination Method, Eigenvalues and Eigenvectors, Diagonalisation of Matrix, Cayley Hamilton theorem. Orthogonal, Hermitian and unitary matrices.	**15 Hours**
Unit B	Concept of limit and continuity of a function of two variables, Partial derivatives, Homogenous Function , Euler's Theorem, Total Derivative, Differentiation of an implicit function, chain rule, Change of variables, Jacobian, Taylor's and McLaurin's series. Maxima and minima of a function of two and three variables: Lagrange's method of multipliers.	**14 Hours**
Unit C	Formation of ordinary differential equations, solution of first order differential equations by separation of variables, Homogeneous equations, Reduce to Homogenous, exact differential equations, equations reducible to exact form by integrating factors, equations of the first order and higher degree, clairaut's equation.	**14 Hours**
Unit D	Solution of differential equations with constant coefficients: method of differential operators. Non – homogeneous equations of second order with constant coefficients: Solution by method of variation of parameters, Simultaneously Linear differential equation.	**13 Hours**

Suggested Books:

1. Grewal, B.S. Higher Engineering Mathematics. New Delhi: Khanna Publication, 2009.
2. Kreyszig, Erwin. Advanced Engineering Mathematics. New Delhi: Wiley Eastern Ltd., 2003.
3. Jain, R K, and K Iyengar S R. Advanced Engineering Mathematics, New Delhi: Narosa Publishing House, 2003.
4. Thomas, George B. and Finney Ross L. Calculus and Analytic Geometry. New Delhi Addison Wesley, 1995.

Course Title:	CHEMISTRY		L	T	P	Cr
Course Code:	CHE151A		4	0	0	4
Course Outcome: After completion of course, the students should be able to	CO1	Understanding Spectroscopy and its Applications				
	CO2	UV /IR/ NMR Spectroscopy				
	CO3	Understanding Water and its treatment				
	CO4	Concept of Corrosion and its Prevention				
	CO5	Chemistry in Nanoscience and Technology				

Unit A

Spectroscopy and its Applications

General Introduction: Introduction, electromagnetic spectrum, absorption and emission spectrum, atomic and molecular spectroscopy, types of molecular spectra, experimental techniques, selection rules, width and intensities of spectral lines.

UV/Visible Spectroscopy: types of electronic Transitions, Chromophores, Auxochromes, Effect of conjugation on Chromophores, Factors affecting λmax and intensity of spectral lines, effect of solvent on λmax, isobestic point, applications.

IR Spectroscopy: Infrared region, fundamental modes of vibrations and types, theory of infrared spectra, vibrational frequency and energy levels, an harmonic oscillator, modes of vibrations of polyatomic molecules, characteristic signals of IR spectrum, fingerprint region, factors affecting vibrational frequency; applications.

NMR Spectroscopy: Principle and instrumentation, relaxation processes, proton magnetic resonance spectroscopy, number of signals, Chemical shift, Spin-Spin Splitting, coupling constant, applications.

Hours

Unit B

Water and its treatment

Introduction, hardness of water, degree of hardness, units of hardness, boiler feed water: specification, scales and sludge formation; priming& foaming, boiler corrosion, caustic embrittlement, treatment of boiler feed water, internal treatment of water; softening of water by lime-soda, zeolite and ion exchange methods, desalination of water; Water for domestic use: purification of water for domestic use.

Corrosion and its Prevention

Introduction; different types of corrosion - wet and dry corrosion; mechanism of wet corrosion; comparison of dry and wet corrosion, Types of electrochemical corrosion: galvanic corrosion, concentration cell corrosion or differential aeration corrosion, waterline corrosion, pitting corrosion, crevice corrosion, stress corrosion, intergranular corrosion; other forms of corrosion: atmospheric corrosion, soil corrosion, microbiological corrosion, erosion corrosion, Filliform corrosion, stray current corrosion, passivity, galvanic series, factors influencing corrosion, various methods of corrosion control.

Hours

Unit C

Chemistry in Nanoscience and Technology

Introduction, Materials self-assembly, molecular vs. material self-assembly, hierarchical assembly, self-assembling materials, two dimensional assemblies, mesoscale self-assembly, coercing colloids, nanocrystals, supramolecular structures, nanoscale materials, future perspectives applications, nanocomposities and its applications.

Hours

Unit D	**Polymers and Polymerization** Introduction, monomer and repeating unit, degree of polymerization, functionality, classification of polymers: based on origin, monomers, structure, method of synthesis, tacticity or configuration, action of heat, chemical composition, ultimate form; types of polymerization, specific features of polymers, regularity and irregularity, tacticity of polymers, average molecular weights and size, determination of molecular weight by number average methods, effect of molecular weight on the properties of polymers, introduction to polymer reinforced composites.
	Hours

Suggested Books:

1. William Kemp, *Organic Spectroscopy*, Palgrave Foundations, 1991.
2. D. A. Skoog, F. J. Holler and A. N. Timothy, *Principle of Instrumental Analysis*, 5th Edition., Saunders College Publishing, Philadelphia, 1998.
3. C. P. Poole, Jr., F. J. Owens, *Introduction to Nanotechnology*, Wiley Interscience, 2003.
4. L.E. Foster, Nanotechnology, *Science Innovation & Opportunity*, Pearson Education, 2007.
5. P. Ghosh, *Polymer Science and technology* (2nd Edition), Tata McGraw Hill, 2008.
6. Wiley *Engineering Chemistry*, Second Edition, 2013.

<table>
<tr><td colspan="2">Course Title:</td><td colspan="2">Computer Fundamentals and Programming</td><td>L</td><td>T</td><td>P</td><td>Cr</td></tr>
<tr><td colspan="2">Course Code:</td><td colspan="2">CSE101A</td><td>4</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td colspan="2" rowspan="5">Course Outcome:
After completion of course, the students should be able to</td><td>CO1</td><td colspan="4">Introduction to Computers</td></tr>
<tr><td>CO2</td><td colspan="4">Working Knowledge of Computer System</td></tr>
<tr><td>CO3</td><td colspan="4">Fundamentals of Internet Technology</td></tr>
<tr><td>CO4</td><td colspan="4">Basic Constructs of C</td></tr>
<tr><td>CO5</td><td colspan="4">Concept of array Arrays and Strings</td></tr>
<tr><td>Unit A</td><td colspan="7">Introduction to Computers
Define a Computer System, Block diagram of a Computer System and its working, memories, Volatile and non-volatile memory, cache, virtual, secondary storage devices- Magnetic Tape, Hard Disk, CD-DVD, Magnetic Disk, Various input devices including keyboard, Mouse, Joystick, Scanners and Various output devices including Monitors, Printers, Plotters
Operating Systems
Computer Software and its types and Hardware, Operating Systems, their types and functions</td></tr>
<tr><td colspan="7"></td><td>15 Hours</td></tr>
<tr><td>Unit B</td><td colspan="7">Working Knowledge of Computer System
Introduction to word processors and its features, creating, editing, printing and saving documents, spell check, mail merge, creating power point presentations, creating spreadsheets and simple graphs.
Fundamentals of Internet Technology
Local area networks, MAN and wide area network, Internet, WWW, E-mail, Browsing and Search engines, Internet Connectivity, Network Topology, Hub, Switches, Router, Gateway.</td></tr>
<tr><td colspan="7"></td><td>14 Hours</td></tr>
<tr><td>Unit C</td><td colspan="7">Basic Constructs of C
Keywords, Identifiers, Variables, Data Types and their storage, Arithmetic Operators, Relational Operators, Logical Operators, Bitwise Operators, Increment & Decrement Operators, Expressions, Conditional Expressions, Assignment Operators and Expressions, External Variables and Scope of Variables, Structure of C Program.
Control Structures
Decision making statements: if, nested if, if – else ladder, switch, Loops and iteration: while loop, for loop, do – while loop, break statement, continue statement, goto statement.</td></tr>
<tr><td colspan="7"></td><td>16 Hours</td></tr>
</table>

Unit D	**Functions** Advantages of functions, function prototype, declaring and defining functions, return statement, call by value and call by reference, recursion, and storage classes. **Arrays and Strings** Declaration of arrays, initialization of array, accessing elements of array, I/O of arrays, passing arrays as arguments to a function, strings, I / O of strings, string manipulation functions (strlen, strcat, strcpy, strcmp)
	13 Hours

Suggested Books:

1. V.K. Jain: "*Fundamentals of Information Technology and Computer Programming*", PHI Latest Edition.
2. Anita Goel: "*Computers Fundamentals*", Pearson Publications
3. Brian Kernighan and Dennis M. Ritchie: "*The C Programming Language*", Prentice Hall, 2nd Edition 2007.
4. K.N.King: "*C Programming: A Modern Approach*", W.W. Norton Company 2nd edition (2008).
5. Herbert Schildt: "*C: The Complete Reference*", Tata Mcgraw Hill Publications 4th edition.
6. Gottfired: "*Programming in ANSI C, Schaum Series*", TMH publications, 2nd Edition (1996).
7. Balaguruswamy, E.PROGRAMMING IN ANSI C. Mc-Graw Hill Publications, 7th edition. 2016. Print

Course Title:	Environmental Studies		L	T	P	Cr
Course Code:	EVS100A		4	0	0	S/US
Course Outcome: After completion of course, the students should be able to	CO1	The multidisciplinary nature of environmental studies				
	CO2	Understanding Biodiversity and its conservation				
	CO3	Social Issues and the Environment				
	CO4	Human Population and Environmen				
	CO5	Exposure of field work				

Unit A	**The multidisciplinary nature of environmental studies** Definition, scope and importance, Need for public awareness **Natural Resources: Renewable and non-renewable resources:** Natural resources and associated problems a) **Forest resources:** Use and over-exploitation, deforestation, case studies. Timberextraction, mining, dams and their effects on forests and tribal people. b) **Water resources:** Use and over-utilization of surface and ground water, floods, drought,conflicts over water, dams-benefits and problems. c) **Mineral resources:** Use and exploitation, environmental effects of extracting and usingmineral resources, case studies. d) **Food resources:** World food problems, changes caused by agriculture and overgrazing,effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) **Energy resources:** Growing energy needs, renewable and non-renewable energy sources,use of alternate energy sources, case studies. f) **Land resources:** Land as a resource, land degradation, man induced landslides, soil erosionand desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles. **Ecosystem:** • Concept of an ecosystem • Structure and function of an ecosystem • Producers, consumers and decomposers Energy flow in the ecosystem Ecological succession Food chains, food webs and ecological pyramids Introduction, types, characteristic features, structure and function of the following ecosystem: 2. Forest ecosystem 3. Grassland ecosystem 4. Desert ecosystem 5. Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries)
	14 Hours

Unit B	**Biodiversity and its conservation** • Introduction – Definition: Genetic, Species and Ecosystem Diversity • Bio-geographical classification of India • Value of biodiversity: Consumptive use, Productive use, Social, Ethical, Aesthetic and Option values • Biodiversity at global, national and local levels • India as a mega-diversity nation • Hot-spots of biodiversity • Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts • Endangered and endemic species of India • Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity, global and national efforts. **Environmental Pollution** Definition, causes, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear pollution • Solid waste management: Causes, effects and control measures of urban and industrial wastes. • Role of an individual in prevention of pollution • Pollution case studies • Disaster management: floods, earthquake, cyclone and landslides	**12 Hours**

Unit C	**Social Issues and the Environment** • Population growth, variation among nations, Population explosion – Family Welfare Programmes. • Environment and human health, • From unsustainable to sustainable development • Urban problems and related to energy • Water conservation, rain water harvesting, watershed management • Resettlement and rehabilitation of people; its problems and concerns. Case studies. • Environmental ethics: Issues and possible solutions • Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. • Wasteland reclamation • Consumerism and waste products • Environmental Laws: The Environment Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981; The Water (Prevention and control of Pollution) Act 1974; The Wildlife Protection Act, 1972; Forest Conservation Act, 1980. • Issues involved in enforcement of environmental legislation • Public Awareness
	7 Hours
Unit D	**Human Population and Environment** • Population Growth and Variations among Nations • Population Explosion • Human Rights • Value Education • HIV / AIDS • Women and Child Welfare • Role of Information Technology in Environment and Human Health • Case Studies **Field Work** • Visit to a local area to document environmental assets river/ forest/ grassland/hill/mountain • Visit to a local polluted site – Urban / Rural / Industrial / Agricultural • Study of common plants, insects, birds • Study of simple ecosystems-Pond, river, hill slopes, etc (Field work equal to 5 lecture hours)
	10 Hours
Suggested Books:	

1. Odum, EP. *Basic Ecology*. Japan: Halt Saundurs, 1983.

2. Botkin, DB, and Kodler EA. *Environmental Studies: The Earth as a living planet.* New York: John Wiley and Sons Inc., 2000.

3. Singh, JS, Singh, SP, and Gupta SR. Ecology, *Environment and Resource Conservation.* New Delhi: Anamaya Publishers, 2006.

4. De, AK. *Environmental Chemistry*. New Delhi: Wiley Eastern Ltd., 1990.

5. Sharma, PD. *Ecology and Environment*. Meerut Rastogi Publications, 2004

Course Title:	Engineering Drawing		L	T	P	Cr
Course Code:	MEC101A		2	0	4	4
Course Outcome: After completion of course, the students should be able to	**CO1**	Learn a universal language for engineers.				
	CO2	Learn the concept of first angle and third angle projection.				
	CO3	Learn to develop lateral surface for engineering objects.				
	CO4	Learn to read drawing, use and application of various line types				
	CO5	**Projection of solids**				

Unit A

Drawing Techniques

Introduction to drawing instruments, various types of lines and their convention, principles of dimensioning, Engineering symbols, Gothic lettering in single stroke as per SP-46 code (Vertical and inclined)

Scales

Concept of scaling, construction of plane and diagonal scales

20 Hours

Unit B

Projection of Points

Concept of plane of projections (Principle planes), First and third angle projections; projection of points in all four quadrants, shortest distance problems

Projection of Lines and Planes

Projection of line parallel to both planes, perpendicular to one plane, inclined to one and both the reference planes and their traces. Plane perpendicular to one plane inclined to one and both the reference planes and their traces. Concept of profile plane and auxiliary planes, To find the true length, α, β, θ and Φ.

22 Hours

Unit C

Projection of Solids

Right and oblique solids; solids of revolution and polyhedrons, projection of solid with axis perpendicular to one plane and parallel to one or both reference planes. Projection of solid with axis inclined to one or both reference planes.

Sectioning of Solids

Theory of sectioning, types of section planes, their practice on projection of solids, Sectioning by auxiliary planes, to find true section of truncated solids.

16 Hours

Unit D

Development of Surfaces

Method of Development, Development of surfaces: Parallel line and Radial line method. Development of oblique solids, Development of curved surfaces.

Orthographic and Isometric Views

Draw orthographic views from isometric view or vice-a-versa, Missing line and missing view

18 Hours

Suggested Books:

1. Jolhe, A.J., "*Engineering Drawing*", Tata McGraw-Hill, New Delhi.
2. Gill, P.S., *"Engineering Drawing",* S.K. Kataria and Sons, Ludhiana
3. French T.E. and Vierck, C.J., *"Graphic Science"*, McGraw-Hill, New York
4. Zozzora F., *"Engineering Drawing",* McGraw Hill, New York

Course Title:	Basic Communication Skills		L	T	P	Cr
Course Code:	ENG151		3	0	0	3
Course Outcome: After completion of course, the students should be able to	**CO1**	Improve their writing skills as well as will enrich their word power.				
	CO2	**Applied Grammar (Socio-Cultural Context)**				
	CO3	**Reading (Communicative Approach to be followed)**				
	CO4	Essay Writing and Letter Writing				
	CO5	Group Discussion & Facing an Interview				

Unit A

Applied Grammar (Socio-Cultural Context)

1. Parts of Speech: Noun, Pronoun, Adjective, Verb, Adverb, Preposition, Conjunction, Interjection
2. Tenses (Rules and Usages in Socio-cultural contexts)
3. Modals: Can, Could, May, Might, Will, Would, Shall, Should, Must, Ought to
4. Passive/Active
5. Reported/Reporting Speech

Hours

Unit B

Reading (Communicative Approach to be followed)

1. J M Synge: Riders to the Sea (One Act Play)
2. Anton Chekhov: Joy (Short Story)
3. Swami Vivekanand: The Secret of Work (Prose)

Hours

Unit C

Writing

1. Essay Writing and Letter Writing
2. Report Writing
3. Group Discussion & Facing an Interview

Hours

Unit D

Hours

Suggested Books:

1. Kumar, Sanjay and PushpLata. *Communication Skills*. India: OUP, 2012. Print.
2. Vandana, R. Singh. *The Written Word* by. New Delhi: Oxford University Press, 2008. Print.

b. Websites

1. www.youtube.com (to download videos for panel discussions). Web.
2. www.letterwritingguide.com. Web.
3. www.teach-nology.com.Web.
4. www.englishforeveryone.org.Web.
5. www.dailywritingtips.com.Web.
6. www.englishwsheets.com.Web.
7. www.mindtools.com.Web.

Course Title:	Chemistry Laboratory		L	T	P	Cr
Course Code:	CHE152		0	0	2	1
Course Outcome: After completion of course, the students should be able to	CO1	Use of spectrometers				
	CO2	Determining strength/ Hardness of solutions				
	CO3	Determining surface tension of liquid				
	CO4	Determining flesh and fire point				
	CO5	Determining viscosity				

List of Experiments:

1. Verify Lambert Beer's law using spectrophotometer and $CoCl_2$ or $K_2Cr_2O_7$ solution.
2. Determine the strength of HCl solution by titrating against NaOHsolutionconductometerically.
3. Determination of the strength of HCl solution by titrating against NaOH using pH meter.
4. Determination of total hardness of water (tap) using standard EDTA solution and Eriochrome black T indicator.
5. Determination of alkalinity of water.
6. Determination of surface tension of given liquid by using Stalagmometer.
7. Determination of residual chlorine in a water sample.
8. Determination of Flash & Fire point of given a given lubricating oil by Pensky-Marten's apparatus.
9. Determination of the viscosity of given lubricating oil by using Redwood Viscometer.
10. Preparation of a polymer phenol/urea formaldehyde resin.
11. Determination of moisture, volatile matter and ash content in a given sample of coal by proximate analysis.
12. Determination of dissolved oxygen present in given sample of water.

<table>
<tr><td>Course Title:</td><td colspan="2">Computer Fundamentals and Programming Lab</td><td>L</td><td>T</td><td>P</td><td>Cr</td></tr>
<tr><td>Course Code:</td><td colspan="2">CSE103</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td rowspan="5">Course Outcome:
After completion of course, the students should be able to</td><td>CO1</td><td colspan="5">Practical know-how of various internal and external Hardware components of a computer</td></tr>
<tr><td>CO2</td><td colspan="5">Introduction to Operating Systems;</td></tr>
<tr><td>CO3</td><td colspan="5">MS-Word, MS-Excel, MS-Power point</td></tr>
<tr><td>CO4</td><td colspan="5">Concept of programming Language</td></tr>
<tr><td>CO5</td><td colspan="5">Concept of Internet/IOT</td></tr>
<tr><td colspan="7">This course provides a practical aspect of Circuit Analysis using Ohm's law, Kirchhoff's laws and network theorems, to understand the constructional detail of Electrical machines.</td></tr>
<tr><td>List of Experiments:</td><td colspan="6">1. Practical know-how of various internal and external Hardware components of a computer (including basic working of peripheral devices).
2. Introduction to Operating Systems; installing Windows; basics of windows.
3. Working knowledge of Internet.
4. Introduction to word processor and mail merge.
5. Introduction to MS-Excel.
6. Working on MS-PowerPoint.
7. Introduction to basic structure of C program, utility of header and library files.
8. Implementation of program related to the basic constructs in C
9. Programs using different data types in C
10. Programs using Loops and Conditional Statements in C
11. Programs using functions by passing values using call by value method.
12. Programs using functions by passing values using call by reference method.
13. Programs using arrays single dimension in C.
14. Program to implement array using pointers
15. Programs related to string handling in C</td></tr>
</table>

Course Title:	Basic Communication Skills Lab		L	T	P	Cr
Course Code:	ENG152		0	0	2	1
Course Outcome: After completion of course, the students should be able to	CO1	Students will get exposure to speaking through the above-mentionedinteractive exercises.				
	CO2	they will develop a technical understanding of language learning software, which will further improve their communicative skills.				
	CO3	**Understanding Video editing**				
	CO4	**Impact of role play in concept visualization**				
	CO5	**Importance of group discussion**				

List of Experiments:

Unit – A Speaking/Listening

1. Movie-Clippings (10 Hours)
2. Role Plays (10 Hours)
3. Group Discussions (10 Hours)

Course Title:	Engineering Mathematics-II		L	T	P	Cr
Course Code:	MTH152A		4	0	0	4
Course Outcome: After completion of course, the students should be able to	CO1	Understanding Functions of Complex Variables				
	CO2	Understanding Integral Calculus/ Multiple Integrals				
	CO3	UnderstandingVector Calculus:				
	CO4	Understanding Vector differential operators				
	CO5	A Convergence and divergence of series and its in-depth analysis				

Unit A	**Functions of Complex Variables**: Complex Numbers and elementary functions of complex variable De-Moivre's theorem and its applications. Real and imaginary parts of exponential, logarithmic, circular, inverse circular, hyperbolic, inverse hyperbolic functions of complex variables.Summation of trigonometric series. (C+iS method).
	13 Hours
Unit B	**Integral Calculus:** Rectification of standard curves; Areas bounded by standard curves;Volumes and surfaces of revolution of curves; **Multiple Integrals**: Double and triple integral and their evaluation, change of order ofintegration, change of variable, Application of double and triple integration to find areas and volumes. Centre of gravity and Moment of inertia
	15 Hours
Unit C	**Vector Calculus:** Scalar and vector fields, differentiation of vectors, velocity and acceleration. **Vector differential operators**: Del, Gradient, Divergence and Curl, their physicalinterpretations. Line, surface and volume integrals. **Application of Vector Calculus**: Flux, Solenoidal and Irrotational vectors. Gauss Divergencetheorem.Green's theorem in plane, Stoke's theorem (without proofs) and their applications
	15 Hours
Unit D	**Infinite Series:** Convergence and divergence of series, Tests of convergence (without proofs): Comparison test, Integral test, Ratio test, Raabe's test, Logarithmic test, Cauchy's root test and Gauss test. Convergence and absolute convergence of alternating series, Uniform Convergence and Power Series
	14 Hours

Suggested Books:

1. Grewal, B.S., *Higher Engineering Mathematics*. New Delhi: Khanna Publication, 2009
2. Kreyszig, Erwin, *Advanced Engineering Mathematics*. New Delhi: Wiley Eastern Ltd., 2003.
3. Jain, R K, and K Iyengar S R., *Advanced Engineering Mathematics*, New Delhi: Narosa Publishing House, 2003.
4. Thomas, George B. and Finney Ross L., *Calculus and Analytic Geometry*. New Delhi Addison Wesley, 1995

Course Title:	ENGINEERING PHYSICS		L	T	P	Cr
Course Code:	PHY151B		4	0	0	4
Course Outcome: After completion of course, the students should be able to	CO1	Understanding principle of optics				
	CO2	Understanding LASER and fibre optics				
	CO3	Understanding concept of dielectrics				
	CO4	Understanding quantum computing				
	CO5	Understanding super conductivity				

Unit A	**PHYSICAL OPTICS**: **Interference:** Division of wave front, Fresnel's biprism, division of amplitude, Newton's rings and applications. **Diffraction:** Difference between Fraunhofer and Fresnel diffraction, Fraunhofer diffraction through a slit, plane transmission diffraction grating, its dispersive and resolving power. **Polarization**: Polarized and unpolarized light, double refraction, Nicol prism, quarter and half wave plates.	**15Hours**
Unit B	**LASER**: Spontaneous and stimulated emission, Laser action, Characteristics of laser beam, concept of coherence, He-Ne laser, Semiconductor laser, Ruby laser and applications, Holography. **FIBRE OPTICS**: Propagation of light in fibres, numerical aperture, single mode and multimode fibres, applications	**15 Hours**
Unit C	**DIELECTRICS:** Molecular Theory, polarization, displacement, susceptibility, dielectric coefficient, permittivity, relations between electric vectors, Gauss's law in the presence of a dielectric, energy stored in an electric field, Behavior of dielectric in alternating field and clausius-Mossotti equation.	**13 Hours**
Unit D	**QUANTUM MECHANICS**: Difficulties with Classical physics, Introduction to quantum mechanics simple concepts, Black Body radiation, Planck's Law of radiation and its limitations, Group velocity and phase velocity, Schrodinger's wave equations and their applications. **NANOPHYSICS:** Introduction to Nanoscience and Nanotechnology, Electron confinement, Nanomaterials, Nanoparticles, Quantum structure, CNT, Synthesis of Nanomaterials and Application of Nanomaterials. **SUPER CONDUCTIVITY**: Introduction (experimental survey), Meissner effect, Type I and type II superconductors, London equation, Elements of BCS theory, Applications of superconductors.	**18 Hours**
Suggested Books:		

1. Sear, F.W. Electricity and Magnetism. London: Addison-Wesley, 1962.
2. Resnick and Halliday. Physics.New York: Wiley, 2002.
3. Lal,B. and Subramanyam, N.A Text Book of Optics. New Delhi: S. Chand and Company Limited, 1982.
4. Jenkins, and White. Fundamental of Physical Optics. New York: Tata McGraw-Hill, 1937.
5. Griffiths,D. Introduction to Electrodynamics, New Delhi: Prentice Hall, 1998.
6. Beiser, A. Perspective of Modern Physics. New Delhi: McGraw Hill Ltd., 2002.
7. Verma, N.K Physics for Engineers. New Delhi: Prentice Hall, 2014.

Course Title:	Mechanical Engineering Fundamentals		L	T	P	Cr
Course Code:	MEC103		4	0	0	4
Course Outcome: After completion of course, the students should be able to	**CO1**	Know about the different thermodynamic processes and design principles.				
	CO2	Know about the different pressure-measuring units and devices.				
	CO3	Recognize the different power transmission devices, machine elements, and their applications.				
	CO4	Know about various power producing and power absorbing devices and their working.				
	CO5	**Basic know how of IC Engines**				
Unit A	**Fundamental Concepts of Thermodynamics** Introduction, Thermodynamic System and its types, Boundary and its types, Surroundings, Thermodynamic properties, State, Path, process and cycles, Thermodynamic Equilibrium, Working Substance, Microscopic and Macroscopic Analysis, Units and Dimensions, Quasi Static Process, Reversible and Irreversible processes, Point Function and Path Function, Mechanical and Thermodynamic work, P-dv Work (Displacement Work), Work is a Path Function, Equations for work done in various processes **Laws of Thermodynamics:** Zeroth law of Thermodynamics, Temperature, Thermometry (Measurement of temperature), Temperature Scales, Energy, Potential and Kinetic Energies at Micro and Macro Level, Internal Energy, Law of conservation of energy, Joule's Experiment, First law of thermodynamics (Open and Closed System), Energy – A property of system, Enthalpy, Entropy, Heat, Heat vs Temperature, specific heat, Heat Capacity, Specific heat at constant volume, Specific heat at constant pressure, Adiabatic Index, Limitations of first law of thermodynamics					
						15 Hours
Unit B	**Heat Transfer:** Introduction, Heat Transfer vs Thermodynamics, Applications, Thermal Conductivity, Thermal Resistance, Modes of heat transfer, Spectrum of electromagnetic radiation, Surface emission properties, Absorptivity, Reflectivity and Transmissivity, Fourier law, Newton's law of cooling, Stefan Boltzmann's Law, Heat Exchangers (Applications, Selection, Classification), Thermal Insulation (Properties of insulation, Types of Insulations, Thermal Insulating Materials) **Power Absorbing Devices**: Power Absorbing Devices, Difference between Hydraulic pump, Air compressor, Fan, Blower, Pump (Function, Selection, Applications), Classification of Pump, Positive displacement and Dynamic Pumps, Reciprocating Pumps and its types, Rotary Pumps and its types, Centrifugal Pump, Axial Pump					
						12 Hours

Unit C	**Power Producing Devices Boiler:** States of matter, Changing State of Matter, Sublimation, Effect of temperature during change of Phase, Steam boiler, Application, Classification of boilers, Types of boilers (Brief Description), Essentials of a good boiler, Advantages of superheating the steam, Comparison between Water tube and Fire tube boilers, Function of boiler Mountings and Accessories **Turbines:** Turbine, Classification based on working fluid, Classification of hydraulic turbines, Selection of hydraulic turbines, Impulse Turbines (Pelton Wheel/ Turgo/ Cross Flow), Reaction Turbines (Francis/ Kaplan/ Propeller) **Internal Combustion Engines:** Heat Engine, Types of Heat Engine, Advantages, Disadvantages and Applications, Classification of IC Engine, Engine Components (Location, Function and Material), Basic Terminology used in IC engine, Four stroke Cycle Engines (SI and CI), Two stroke Cycle Engines (SI and CI)
	11 Hours
Unit D	**Principles of Design:** Need of design, Product Life Cycle, Material properties and selection, Factors affecting material selection, Stress and Strain and its types, Hooke's law, Modulus of Elasticity, Longitudinal and Lateral Strain, Poisson's ratio, Stress- Strain Curve for ductile material and brittle material, Factor of Safety, Centre of Gravity, Centroid, Centroid of areas of plain, Figures (WithoutDerivation), Centroid of areas of composite sections (Without Derivation), Moment of Inertia, Radius of gyration, Theorem of perpendicular axis, Theorem of parallel axis, MI of L, I and T sections, [Simple problems on above topics] **Power Transmission Devices and Machine Elements:** Individual and group drive system (advantages and Disadvantages), Belt drive (Types: V and Flat Belts and their Applications, Advantages and Disadvantages), Ropes drive (Types: Fiber and Wire Ropes and their Applications, Advantages and Disadvantages), Chain drive (Applications, advantages and Disadvantages, Sprockets), Gear drive (Types of Gears), Power transmission shafts, Types of shafts, Application of shafts, Axle, Keys (Function, Classification), Coupling (Function, Classification: Rigid and Flexible), Flanged coupling, Oldham's coupling, Universal coupling, Bearings and their types, Flywheel construction and types
	13 Hours

Suggested Books:

1. Rajan T.S. *Basic Mechanical Engineering*, New Delhi: New Age Publishers.
2. Singh Sadhu *Principles of Mechanical Engineering*, New Delhi: S Chand Publishers.
3. Shankar V.P., *Basic Mechanical Engineering*, New Delhi: Laxmi Publishers.
4. Phthak G. K., *Basic Mechanical Engineering*, New Delhi: Rajsons Publications.
5. Kumar Parveen, *Basic Mechanical Engineering*, New Delhi: Pearson Education

Course Title:	Basic Electrical Engineering		L	T	P	Cr
Course Code:	ELE105		4	0	0	4
Course Outcome: After completion of course, the students should be able to	**CO1**	Apply the knowledge of Electrical Engineering principles to solve DC and AC circuits.				
	CO2	Formulate and analyse electrical circuits. Understand basic principles of electromagnetism				
	CO3	Understand electrical machines and transformers.				
	CO4	Identify and select various electrical machines according to the applications.				
	CO5	Apply the ethical principles for troubleshooting & installation of safety devices as per norms of				

202	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L2, L4	L2	L3	L3

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	1	1	1	-	-	1	2	1	-	3	3	1
CO2	3	3	-	2	-	1	-	-	2	-	-	-	3	1
CO3	3	1	2	3	1	-	1	-	2	1	1	3	3	1
CO4	3	-	2	-	-	1	-	1	2	1	-	2	3	1
CO5	2	2	3	1	1	1	-	-	2	1	-	2	2	1

Unit A	**D.C Circuit Analysis:**Voltage source, current source, dependent and independent sources, analysis of D.C circuit by KCL and KVL, Nodal and Mesh analysis, Superposition theorem, Maximum Power Transfer Theorem, Thevenin and Norton Theorems.	**10 Hours**
Unit B	**A.C Circuit Analysis:**Review of single phase A.C. circuit under sinusoidal steady state, RMS Value , Average Value, Form factor, Peak factor solution of RL, RC, R.L.C. Series circuit, the j operator, complex representation of impedance, solution of series circuit, series & parallel resonance, 3 phase A.C. Circuit, star and delta connections, line and phase quantities solution of 3 phase circuits, balance supply voltage and balanced supply voltage and balance load, Phasor diagram, power triangle, measurement of power and power factor by wattmeter method.	**15 Hours**

Unit C	**Magnetic Circuit & Transformers:**Review of magnetic circuits, B-H Curve, saturation leakage and fringing. Hysteresis and eddy currents. Single phase transformer, basic concepts constructional detail, emf equation of single-phase transformer, voltage, current Transformation equivalent circuit under no load condition, Ideal transformer and its phasor diagram, voltage regulation, losses and efficiency. **Autotransformer:** its construction, advantages, disadvantages and applications.
	15 Hours
Unit D	**Rotating Electrical Machines:**Basic concepts, working principle and general construction of DC machines (motor/generators), torque and EMF expression. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components, efficiency, starting, and speed control of induction motor. **Electrical Installations:** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Various faults in Batteries, Elementary calculations for energy consumption, power factor improvement and battery backup.
	15 Hours

Suggested Books:

1. Edward, Hughes. Hughes Electrical and Electronic Technology. Pearson Education India, 2010.
2. Nagsarkar, T. K., and M. S. Sukhija. Basic electrical engineering. Oxford Univ. Press, 2005.
3. Nagrath, I. J. Basic Electrical Engineering. Tata McGraw-Hill Education, 2001.
4. Mittal, VN MittleArvind. Basic electrical engineering. Tata McGraw-Hill, 2004.
5. Theraja, A. K. "Electrical technology." (2006).
6. Naidu, M. S., and S. Kamakshaiah. Introduction to electrical engineering. Tata McGraw-Hill Education, 1995.
7. Theraja, B. L., and R. S. Sedha. "Principles of electronic devices and circuits." Chand & (2004).
8. Del Toro, Vincent. Electrical Engineering Fundamentals. Prentice Hall, 1972.
9. Del Toro, Vincent. Principles of Electrical Engineering. Prentice Hall, 1972.

<table>
<tr><td colspan="2">Course Title:</td><td colspan="2">Human Values and General Studies</td><td>L</td><td>T</td><td>P</td><td>Cr</td></tr>
<tr><td colspan="2">Course Code:</td><td colspan="2">SGS107B</td><td>4</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="2" rowspan="5">Course Outcome:
After completion of course, the students should be able to</td><td>CO1</td><td colspan="4">Concept of Human value and ethics</td></tr>
<tr><td>CO2</td><td colspan="4">Value base living : concept</td></tr>
<tr><td>CO3</td><td colspan="4">Glimpses of history and geography</td></tr>
<tr><td>CO4</td><td colspan="4">Preliminary general science</td></tr>
<tr><td>CO5</td><td colspan="4">Current affairs</td></tr>
<tr><td colspan="2">Course Objective:</td><td colspan="6">This course provides basic knowledge of DC and AC Circuit Analysis and Network Theorems, Magnetic Circuits and various electrical devices & installation e.g. MCB, ELCB, MCCB, DC Machines, AC Machines etc.</td></tr>
<tr><td colspan="2">Learning Outcomes:</td><td colspan="6">Apply the knowledge of Electrical Engineering principles to solve DC and AC circuits. Formulate and analyze electrical circuits. Understand basic principles of electromagnetism to implement in electrical machines and transformers. Identify and select various electrical machines according to the applications. Apply the ethical principles for troubleshooting & installation of safety devices as per norms of engineering practice</td></tr>
<tr><td>Unit A</td><td colspan="7">Human Values
Concept of Human Values: Meaning, Types and Importance of Values.
Value Education: Basic guidelines forvalue education
Value crisis and its redressal
Being Good and Responsible
Self-Exploration and Self Evaluation
Acquiring Core Values for Self Development
Living in Harmony with Self, Family and Society
Values enshrined in the Constitution: Liberty, Equality
Fraternity and Fundamental Duties.</td></tr>
<tr><td colspan="7"></td><td>15 Hours</td></tr>
<tr><td>Unit B</td><td colspan="7">Value – based living
Vedic values of life
Karma Yoga andJnana Yoga
Ashta-Margaand Tri-Ratna
Ethical Living:
Personal Ethics
Professional Ethics
Ethics in Education</td></tr>
<tr><td colspan="7"></td><td>13 Hours</td></tr>
</table>

Unit C	**General Geography** **World Geography** The Universe, The Solar System, The Earth, Atmosphere, The World we live in, Countries rich in Minerals, Wonders of the World, Biggest and Smallest. **Indian Geography** Location, Area and Dimensions, Physical Presence, Indian States and Union Territories, Important sites and Monuments, Largest-Longest and Highest in India. **General History** Glimpses of India History, Ancient Indian, Medieval India, Modern India, Various Phases of Indian National Movement, Prominent Personalities, Glimpses of Punjab history with special reference to period of Sikh Gurus **Glimpses of World History** Important Events of World History, Revolutions and Wars of Independence, Political Philosophies like Nazism, Fascism, Communism, Capitalism, Liberalism etc. **Indian Polity: Constitution of India** Important Provisions, Basic Structure, Union Government, Union Legislature and Executive, State Government: State Legislature and Executive, Indian Judiciary, The Election Commission, Panachayati Raj System, RTI etc. **General Economy** The process of liberalization, privatization, globalization and Major World Issues, Indian Economy, Indian Financial System, Major Economic Issues, Economic Terminology.
	18 Hours
Unit D	**General Science** General appreciation and understandings of science including the matters of everyday observation and experience, Inventions and Discoveries **Sports and Recreation** The World of Sports and recreation, Who's Who is sports, Major Events, Awards and Honours. Famous personalities, Festivals, Arts and Artists **Current Affairs** National and International Issues and Events in News, Governments Schemes and Policy Decisions **Miscellaneous Information Who is who** Books and Authors, Persons in News, Awards and Honours, Abbreviations and Sports
	11 Hours
Suggested Books:	

1. Human Values, A N Tripathi, New Age International Publishers, New Delhi, Third Edition, 2009
2. Professional Ethics, R. Surbiramanian, Oxford University Press, New Delhi, 2013.
3. Human Values and Professional Ethics, RishabhAnand, SatyaPrakashan, New Delhi, 2012
4. Human Values and Professional Ethics, SanjeevBhalla, SatyaPrakashan, New Delhi, 2012.
5. Human Values and Professional Ethics, RituSoryanDhanpatRai& Co. Pvt. Ltd., First Edition, 2010.
6. Human Values and Professional Ethics by Suresh Jayshree, RaghavanB S, S Chand & Co. Ltd, 2007.
7. Human Values and Professional Ethics, Yogendra Singh, AnkurGarg, Aitbs publishers, 2011.
8. Human Values and Professional Ethics, Vrinder Kumar, Kalyani Publishers, Ludhiana, 2013.
9. Human Values and Professional Ethics, R R Gaur, R. Sangal, GP Bagaria, Excel Books, New Delhi 2010.
10. Values and Ethics, Dr.BramwellOsula, Dr.SarojUpadhyay, Asian Books Pvt. Ltd., 2011.
11. Indian Philosophy, S. Radhakrishnan, George Allen &Unwin Ltd., New York: Humanities Press INC, 1929.
12. Essentials of Hinduism, Jainism and Buddhism, A N Dwivedi, Books Today, New Delhi – 1979
13. Dayanand: His life and work, SurajBhan, DAVCMC, New Delhi – 2001.
14. Esence of Vedas, KapilDevDwivedi, Katyayan Vedic SahityaPrakashan, Hoshiarpur, 1990.
15. Vedic Concepts, Prof. B BChaubey, Katyayan Vedic SahityaPrakashan, Hoshiarpur, 1990.
16. Advance Objective General Knowledge, R. S. Aggarwal, S. Chand Publisher (2013)
17. Concise General Knowledge Manual 2013, S. Sen, Unique Publishers,2013
18. Encyclopedia of General Knowledge and General Awareness by R P Verma, Penguin Books Ltd (2010)
19. General Knowledge Manual 2013-14, Edgar Thorpe and Showick Thorpe, The Pearson, Delhi.
20. General Knowledge Manual 2013-14, MuktikantaMohanty, Macmillan Publishers India Ltd., Delhi.
21. India 2013, Government of India (Ministry of Information Broadcasting), Publication Division, 2013.
22. Manorama Year Book 2013-14, MammenMethew, Malayalam Manorama Publishers, Kottayam, 2013.
23. Spectrum's Handbook of General Studies – 2013-14, Spectrum Books (P) Ltd., New Delhi

CURRENT AFFAIRS

Magazines

Economic and Political Weekly, Yojna, the Week, India Today, Frontline, Spectrum. Competition Success Review, Competition Master, Civil Services Chronicle, Current Affairs, World Atlas Book

Newspapers

The Hindu, Times of India, The Hindustan Times, The Tribune

Course Title:	Manufacturing Practice		L	T	P	Cr
Course Code:	MEC104		0	0	4	2
Course Outcome: After completion of course, the students should be able to	CO1	Explain and strictly adhere to the rules and safety regulations for work in the mechanical workshop				
	CO2	Properly operate the manufacturing equipment in the mechanical workshop				
	CO3	Create and document a typical process plan for manufacturing of a product in the mechanical workshop				
	CO4	Read and use a manufacturing drawing as a definition for the manufacturing of a part				
	CO5	Use gauging equipment to verify that a manufactured part fulfills the requirements specified on a manufacturing drawing				

List of Experiments:

CARPENTRY SHOP

a) Preparation of half lap joint

b) Preparation of Mortise and Tenon Joint

c) Preparation of a Dove & Tail joint

d) To prepare a White board duster

Welding Shop:

a) Preparation of Joint by Arc Welding

b) Preparation of Joint by using Gas Welding

c) Preparation of Joint by MIG/ TIG Welding

d) Preparation of Joint by Spot/ Seam Welding

Smithy Shop

a) To Forge the L – Hook

b) To Forge a Chisel

c) To Forge a Cube from a M.S Round

d) To forge a screw driver

Fitting Shop

a) Filing a dimensioned rectangular or square piece and prepare a sq. fitting

b) Preparation of T fitting male part

c) Preparation of U fitting Female part

d) Internal thread Cutting in Square piece and external thread cutting on a rod and assembling as a paper weight

Foundry Shop:

a) To make a Mould of solid pattern

b) To prepare a mould of sleeve fitting using gating system

c) To make a Mould of Split Pattern using Cope & Drag

d) To check the Hardness of the Mould

e) To check the Moisture Content in the Molding Sand

f) To check the Compressive Strength of Molding Sand

Sheet-Metal Shop

a) Preparation of a funnel from G.I. sheet

b) Preparation of a book rack stand from G.I. Sheet

c) Preparation of a leak proof tray with inclined edges from G.I. Sheet

d) Preparation of a square pen stand from G.I. Sheet with riveting at corners

Machine Shop

a) To make a job using step turning and grooving

b) To make a job using knurling and threading

c) To make a multi operation job on a Lathe machine

d) To make V – slot by using shaper machine

Electrical Shop

a) Layout of electrical tube light wiring

b) Layout of stair case wiring using two way switch

c) Testing and rectification of simulated faults in electrical appliances such as 'Electric Iron' Ceiling Fan. Electric kettle

d) To fabricate a circuit for the electrical wiring of, Fan with regulator and Bulb through a main switch and its testing using a series lamp

<table>
<tr><td colspan="2">Course Title:</td><td colspan="2">Engineering Physics Lab</td><td>L</td><td>T</td><td>P</td><td>Cr</td></tr>
<tr><td colspan="2">Course Code:</td><td colspan="2">PHY152A</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td colspan="2" rowspan="5">Course Outcome:
After completion of course, the students should be able to</td><td>CO1</td><td colspan="5">Determination of Refractive Index of the Material</td></tr>
<tr><td>CO2</td><td colspan="5">Determination of wave length of the Material</td></tr>
<tr><td>CO3</td><td colspan="5">Determination of fuscous length of lences</td></tr>
<tr><td>CO4</td><td colspan="5">Calculation of unknown Resistance/ Inductance/ Capacitance</td></tr>
<tr><td>CO5</td><td colspan="5">study the Planck’s constant by using photoelectric cell method.</td></tr>
<tr><td colspan="8">Experimental skills:General Precautions for measurements and handling of equipment,representation of measurements, Fitting of given data to a straight line, and Error analysis, Significant figures and interpretation of results.</td></tr>
<tr><td>List of Experiments:</td><td colspan="7">1. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
2. To determine the Dispersive Power and resolving power of the Material of a given Prism using Mercury Light.
3. To determine wavelength of sodium light using Newton’s Rings.
4. To determination Wavelength of Sodium Light using Michelson’s Interferometer.
5. To determine the wavelength of Laser light using Diffraction of Single Slit.
6. To determine the wavelength of (1) Sodium and (2) Mercury Light using Plane Diffraction Grating.
7. To determine the (1) Wavelength and (2) Angular Spread of HeNe Laser using Plane Diffraction Grating.
8. To study the wavelength of spectral lines of sodium light using plane transmission grating.
9. To study the specific rotation of sugar solution Laurent’s half shade polarimeter method
10. To study the numerical aperture and propagation losses using HeNe laser Optical fibre set up.
11. To compare the focal length of two lenses by Nodal slide method.
12. To find the unknown low resistance by Carey Foster bridge.
13. To determine the beam divergence of the HeNe laser.
14. To study the Meissner’s effect in superconducting sample.
15. To study the Faraday law of electromagnetic induction.
16. To study the capacitance by flashing/quenching of Neon bulb kit
17. To compare the two unknown capacitances of two capacitors by using DeSauty’s bridge.
18. To find our out the unknown inductance by using the Anderson’s bridge method.
19. To study the numerical aperture and propagation losses for He-Ne laser by using the optical fibre set up for
20. To study the Planck’s constant by using photoelectric cell method.</td></tr>
</table>

Course Title:	Basic Electrical Engineering Laboratory	L	T	P	Cr
Course Code:	ELE106	0	0	2	1

Course Outcome: After completion of course, the students should be able to		
	CO1	Identify DC and AC circuits
	CO2	Formulate and analyze electrical circuits for voltage, current and power measurements
	CO3	Apply the ethical principles for troubleshooting & installation of safety devices as per norms of engineering practice
	CO4	Interpret basic principles of electromagnetism to implement in electrical machines and transformers.
	CO5	Recognize and select various electrical machines according to the applications.

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1,L2	L2,L3	L3	L4	L5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Specific Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	-	1	-	-	3	2	1	3	1	1
CO2	3	3	-	2	1	-	-	1	3	-	-	3	2	1
CO3	3	-	1	2	-	1	2	-	-	2	1	3	2	2
CO4	3	3	-	-	1	-	-	1	3	2	3	-	3	3
CO5	3	-	1	2	-	1	-	-	2	-	3	3	2	1

This course provides a practical aspect of Circuit Analysis using Ohm's law, Kirchhoff's laws and network theorems, to understand the constructional detail of Electrical machines.

List of Experiments:	1. To verify Ohm's Law, Kirchhoff's Current Law and Kirchhoff's Voltage Law. 2. To verify Thevenin's and Norton's theorems. 3. To verify Superposition theorem. 4. To verify Maximum Power Transfer theorem. 5. To study frequency response of a series R-L-C circuit and determine resonant frequency and Q-factor for various values of R, L and C 6. To study frequency response of a parallel R-L-C circuit and determine resonant frequency and Q-factor for various values of R, L and C. 7. To perform direct load test of a transformer and plot efficiency versus load characteristics. 8. To perform open circuit and short circuit test on transformer. 9. To perform speed control of DC motor. 10. Measurement of power in a three phase system by two-wattmeter method. 11. Basic safety precautions. Introduction and use of measuring instruments – voltmeter,ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors. 12. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor) 13. To study various starting methods of three phase induction motor. a. DOL Starter b. Auto- transformer starter c. Star-delta starter 14. To study speed control of three phase induction motor. (V/F control)

Course Title:	Network Analysis & Synthesis		L	T	P	Cr
Course Code:	ELE201A		4	0	0	4
Course Outcome: After completion of course, the students should be able to	CO1	be familiar with the fundamental concepts of network analysis.				
	CO2	know and apply the network theorems.				
	CO3	know about Network topologies and Graph Theory				
	CO4	determine two port network parameters and system responses				
	CO5	be familiar with the fundamental concepts of synthesis of two-port passive networks and learn various characteristics of Filters.				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1	L3	L2	L4	L5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	2	-	-	1	-	-	1	1	1	3	1	1
CO2	3	1	2	-	2	-	-	-	3	-	-	2	-	1
CO3	3	3	-	3	3	1	-	-	3	2	1	-	-	2
CO4	3	2	3	2	-	1	-	-	2	2	-	3	-	1
CO5	3	2	3	-	3	1	-	-	2	-	1	2	-	1

Unit A

Circuit Concepts and Network Theorems: Energy Sources, Independent and dependent sources, Source transformation, star & delta transformation, Kirchhoff's Laws, Nodal and Mesh analysis in electric circuits, A.C. and D.C. Network Theorems: Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum Power Transfer theorem, Millman's theorem, Reciprocity theorem, Substitution theorem, Compensation theorem, Tellegen's theorem, Numerical Problems. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits.

12 Hours

Unit B

Graph Theory: Concept of network graph, terminology used in network graph, relation between twigs and links, formation of incidence matrix, tie-set matrix, cut-set matrix, and Kirchhoff's voltage law into topological form, Kirchhoff's current law into topological form, relationship between branch voltage matrix, twig voltage matrix and node voltage matrix, relation between branch current matrix and loop current matrix.

14 Hours

Unit C	**Two Port Network Analysis:** Introduction, Network elements, classification of network, network configuration, Open Circuit Impedance Parameters, Short-Circuit admittance parameters, Hybrid Parameters, ABCD Parameters, Inter-Relationships between parameters of two port network, Expression of Input-Output impedances in terms of two port parameters, different types of interconnections of two port networks. **Time and Frequency Domain Analysis:** Representation of basic circuits in terms of generalized frequency and their response, Laplace transform of shifted functions, transient and steady response.
	14 Hours
Unit D	**Network Synthesis**: Network functions, Impedance and Admittance function, Transfer functions, Hurwitz Polynomials, Positive real functions, LC Network Synthesis, Foster's Canonical Form, Relationship between transfer and impulse response, poles and zeros and restrictions, Network function for two terminal pair network, Sinusoidal network in terms of poles and zeros, Real liability condition for impedance synthesis of RL and RC circuits, Network synthesis techniques for 2-terminal network, Foster and Cauer forms. **Filters:** Classification of filters, characteristics impedance and propagation constant of pure reactive network, Ladder network, T-section, π-section, terminating half section, Pass bands and stop bands, Design of constant-K, m-derived filters, Composite filters.
	12 Hours

Suggested Books:

1. ChakrabortyAbhijit*Circuit Theory* 2nd Edition, DhanpatRai& Sons, 2001.
2. Bird John *Electrical Circuit Theory and Technology* 2nd Edition, Newness.
3. Chaudhury D. Roy *Networks and Synthesis* New Age International 2010.
4. Edminister J.A. *Electric Circuits* 4th Edition, Tata McGraw Hill, 2002.
5. Iyer T.S.K.V. *Circuit Theory* Tata McGraw Hill, 2006.
6. Mohan, Sudhakar Sham *Circuits and Networks Analysis and Synthesis* 2nd Edition, Tata McGraw Hill, 2005.
7. Van Valkenberg, M.E. *Network Analysis and Synthesis* PHI learning, 2009.

Course Title:	Generation and Control of Power		L	T	P	Cr
Course Code:	ELE216		4	0	0	4
Course Objective:	This course provides a comprehensive understanding of various power plant for generating electricity. Various characteristics and selection criteria for power plants.					
Course Outcome: After completion of course, the students should be able to	CO1	Understand the concepts of load, load curve and power plant economics				
	CO2	Identify the objective and design of Tariff.				
	CO3	Understand and interpret the concept of generation of energy plants				
	CO4	Understand automatic control of generation.				
	CO5	Apply the ethical principles for environmental constraints and their remedies in generation of power.				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2, L4	L2, L3, L5	L1, L2	L2	L1, L2

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	1	2	1	2	1	1	2	1	2	3	3	1
CO2	3	3	1	1	-	2	-	1	2	-	2	2	3	1
CO3	3	1	1	-	-	2	2	1	2	-	-	3	3	1
CO4	3	-	1	-	-	-	-	3	2	-	-	2	3	1
CO5	2	1	3	1	-	2	3	1	2	1	-	2	2	1

Unit A

Introduction: Electrical energy sources, organization of power sector in India, single line diagram of thermal, hydro and nuclear power stations. Classification of power plants in base load and peak load plants.

Power Plant Economics: Capital cost of plants, annual fixed cost, operating costs and effect of load factor on cost of energy, depreciation.

Loads and Load curves: Types of load (fixed voltage loads, resistive loads, Inductive motor loads, Mechanical load), effect of load on supply voltage, Maximum demand, Group diversity factor, Peak diversity factor, Types of load, chronological load curves, load-duration Curve, mass curves, load factor, capacity factor, utilization factor, base load and peak load plants, load forecasting.

	12 Hours
Unit B	**Tariffs and power factor improvement:** Objectives of tariff making, different types of tariff (domestic, commercial, agricultural and industrial loads). Need for power factor (p.f.) improvement, power factor improvement using capacitors, determination of economic power factor. **Hydroelectric plants:** Choice of site, classification of hydroelectric plants, main parts and working of plants and their layouts. **Thermal power plants:** Choice of site, main and auxiliary equipment fuel gas flow diagram, water stream flow diagram, working of power plants and their layout.
	13 Hours
Unit C	**Nuclear power plants:** Choice of site, classification of plants, main parts, layout and their working, associated problems. **Diesel power plants:** Diesel plant equipment, diesel plant layout and their working, application of diesel plants. **Combined working of plants:** Advantages of combined operation plant requirements of base load and peak load operation. Combined working of runoff river plant and steam plant. Concept of cogeneration, definition and scope.
	13 Hours
Unit D	**Power station equipment and control:** Excitation system- Purpose and requirements of excitation system, brushless excitation system. Voltage regulators – Function and characteristics of automatic voltage regulators, solid regulator. Speed Governing – Purpose of speed governing system, Hydraulic type, speed-governing system for steam turbines and steam turbines and hydro turbines. Automatic generation control - types of interconnection, advantages of interconnection, real and reactive power control, single area automatic generation control, automatic generation control for two area system, types of automatic generation control for interconnection power systems. **Pollution and environmental problems:** Energy and environment, Air pollution, Aquatic impacts, nuclear plant and hydro plant impacts.
	12 Hours

Suggested Books:

1. Deshpande M.V. *Power Plant Engineering* Tata McGraw Hill, 2004.
2. EI-Wakit M.M. *Power Plant Engineering* McGraw Hill, USA
3. Rajput R.K. *Power Plant Engineering* Luxmi Publications
4. Sharma P.C. *Power Plant Engineering* Kataria and Sons
5. Skrotzki B.G.A. and Vapot W.A. *Power Station Engineering and Economy* Tata McGraw-Hill
6. Arora S.C. and Dom Kundwar S. *A course in Power Plant Engineering* DhanpatRai.
7. Nag, P.K. *Power Plant Engineering* Tata McGraw Hill
8. Gupta B.R. *Generation of Electrical Energy* S. Chand, 1998.
9. Nagrath I.J. and Kothari D.P *Power System Analysis* Tata McGraw-Hill Publication.

Course Title:	Electrical Measurement and Instrumentation	L	T	P	Cr
Course Code:	ELE209A	3	0	0	3
Course Objective:	To understand the basic concepts of measurements in electrical engineering.				

Course Outcome: After completion of course, the students should be able to		
	CO1	acquire knowledge of generalized measurement system , methods of measurement and various instruments
	CO2	be conversant in construction and working of measuring instruments and their proficient use
	CO3	acquire knowledge of the characteristics of measurement system.
	CO4	be competent to handle various instruments for the measurement of electrical quantities
	CO5	be conversant in construction, working of electromechanical indicating instruments and their use

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2,L4	L2,L3	L2,L4	L2, L3,L6	L3,L5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	1	2	2	2	-	-	1	3	2	1	1	1
CO2	3	3	3	2	2	2	1	-	-	2	2	-	2	2
CO3	2	3	3	2	1	2	-	1	1	2	2	2	2	2
CO4	1	2	-	-	2	2	1	-	1	-	-	2	2	2
CO5	2	3	2	3	1	-	-	1	-	1	-	1	-	1

Unit A

Measurements and Measurement Systems: Measurements, significance of measurements, methods of measurements, direct methods, indirect methods, instrument and measurement systems, mechanical, electrical and electronic instruments, classification of instruments, deflection and null type instruments- deflection type, null type, comparison of deflection and null type instruments, Analog and digital modes of operation, functions of instruments and measurement systems, applications of measurement systems, types of instruments systems, information and signal processing, extension of the range of voltmeter and ammeter.

Elements of a generalized measurement system- primary sensing element, variable conversion element, data presentation element, input-output configurations of measuring instruments and measurement systems- desired inputs, inferring inputs, modifying inputs, methods of correction for interfering and modifying inputs.

		12 Hours
Unit B	**Characteristics of instruments and measurement systems:** Measurement system performance, static calibration , static characteristics, errors in measurements, true value, static error, static correction, scale range and scale span, error calibration curve, reproducibility and drift repeatability, noise –signal to noise ratio, source of noise, Johnson noise, power spectrum density, noise factor and noise figure, accuracy and precision, indications of precision, significant figures, range of doubt, possible errors and doubtful figures, static sensitivity, linearity, hysteresis, threshold, dead time, dead zone, resolution of discrimination, loading effects, input and output impedances- input impedances, input admittance, output impedance, output admittance, loading effect due to shunt connected instruments, loading effects due to series connected instruments, generalized impedance and stiffness concepts, static stiffness and static compliance, impedance matching and maximum power transfer. **Potentiometer:** Introduction to basic principle, Laboratory type Crompton's potentiometer, Dual range potentiometer, Volt ratio box, application of dc potentiometer, self-balancing potentiometer.	
		13 Hours
Unit C	**Measurement of Resistances:** Classification of resistances, measurement of medium resistance, Measurement of low resistance (Kelvin double bridge, Ammeter-Voltmeter) and Measurement of high resistance including loss of charge method and Mega ohm bridge method. **AC Bridges:** General theory of ac bridge, Measurement of self-inductance, Measurement of capacitance, Measurement of mutual inductance, Measurement of frequency, Sources of error in ac bridges and their minimization.	
		12 Hours
Unit D	**Electromechanical Indicating Instruments:** Operating forces, Constructional Details, Control System, Torque Weight ratio, Damping System: Air friction Damping, Fluid Friction Damping, Eddy Current Damping, Electromagnetic Damping. **Analog Ammeter, Voltmeter:** Introduction, Types of instruments, PMMC-Construction Torque Equation, MI Instruments- Construction, general Torque Equation, Classification of MI Instruments, Attraction Type, repulsion Type, Extension of range, Advantages & Disadvantages, Applications, Electrodynamometer Type instruments Induction type Energy meter.	
		13 Hours

Suggested Books:

1. Murty D.V. S. *Transducers & Instrumentation* PHI, New Delhi, 2000.
2. Sawhney A. K. *Electrical and Electronics Measurements and Instrumentation*DhanpatRai and Sons,New Delhi, 2000.
3. Kalsi H S *Electronic Instrumentation* Tata McGraw Hill, New Delhi, 4th Edition 2001.
4. Patranabis D. *Sensors and Transducers* PHI, New Delhi, 2003.
5. Doebelin Ernest O *Measurement Systems: Application and Design* Tata McGraw Hill Ltd, New Delhi, 2004.

Course Title:	Electrical Machines-I (DC Machines and Transformers)	L	T	P	Cr
Course Code:	ELE202A	4	0	0	4
Course Objective:	The objective of the course is to enable the students to understand the basic concepts related Electromechanical Energy Conversion, Transformer, DC Motor and DC Generator and their applications				

Course Outcome: After completion of course, the students should be able to		
	CO1	**Understanding Principals of Electromechanical energy system, Singly and doubly excited system**
	CO2	Understand construction and working principle of single phase and auto transformers.
	CO3	acquire the knowledge of three phase transformers, different type of winding connection, parallel operation and testing of transformers
	CO4	Explain construction and working principle of DC generator and various method of improving commutation.
	CO5	Describe the construction, working principle and characteristics of DC motor.

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L2, L4	L2	L3	L3

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	1	1	1	-	-	1	2	1	-	3	3	1
CO2	3	3	-	2	-	1	-	-	2	-	-	-	3	1
CO3	3	1	2	3	1	-	1	-	2	1	1	3	3	1
CO4	3	-	2	-	-	1	-	1	2	1	-	2	3	1
CO5	2	2	3	1	1	1	-	-	2	1	-	2	2	1

Unit A	**Electromechanical Energy Conversion**: Principle of electromechanical energy conversion, calculation of electrical energy input, energy stored in magnetic field, mechanical work done, expression for force and torque for singly excited and doubly excited magnetic system. Force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element	**13 Hours**

Unit B	**Single Phase Transformers:** Principle of single-phase transformer, E.M.F. Equation, turn ratio, phasor diagram of ideal and real transformer at no load and loaded condition, equivalent circuit, OC/SC test voltage regulation, losses and efficiency, all day efficiency and its calculation. Parallel operation of single-phase transformers, division of load between transformers in parallel (equal/unequal voltage ratio). Phase conversion - Scott connection, three-phase to six-phase conversion. **Three Phase Transformers:** Three phase transformers: star/star connection, delta/delta connection, star/delta connection, delta/star connection 0^o and $+30^o$ connection .choice of star delta connection, open delta connection, three winding transformer.
	12 Hours
Unit C	**D.C. Generators:** Constructional detail, voltage equation, lap and wave wound machines, equalizer, connection, armature reaction and method of overcoming its detrimental effects , equivalent circuit of DC generator, separately excited, and self-excite generator , voltage equation and terminal characteristics of shunt, series, and compound DC generator, voltage build up in shunt generator , failure to build up voltage in shunt generator , voltage regulation parallel operation of DC generator
	13 Hours
Unit D	**D.C. Motors:** Torque generated in particle D.C. motor, equivalent circuit of motor, and various types, terminal characteristics of shunt, series and compound motors. Speed control of dc motor by shunt field method and armature voltage method. Ward Leonard speed control method, static ward Leonard method and multi quadrant speed control through ward Leonard method. Need of starter in dc motor, three-point and four starter of dc shunt motors, Testing of DC machines-Swinburne's test and Hopkinson test.
	12 Hours

Suggested Books:

1. Bimbhra P.S. *Electrical Machines Khanna Publisher.*
2. Fitzgerald A.E., Kingsley C. and Umans S.D. *Electric Machinery* 6th Edition, McGraw Hill
3. Langsdorff E.H. *Principles of A.C. Machines* Tata McGraw Hill
4. Nagrath I.J. and Kothari D.P. *Electrical Machine* 4th Edition, Tata McGraw Hill,
5. Say M G *Alternating Current Machine* 5th edition, Sir Isaac pitman& Sons Ltd.

<table>
<tr><td>Course Title:</td><td colspan="2">DC Machines and Transformer Laboratory</td><td>L</td><td>T</td><td>P</td><td>Cr</td></tr>
<tr><td>Course Code:</td><td colspan="2">ELE203A</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td rowspan="5">Course Outcome:
After completion of course, the students should be able to</td><td>CO1</td><td colspan="4">Working of single and three phase transformers</td></tr>
<tr><td>CO2</td><td colspan="4">Working of different types of DC Motors</td></tr>
<tr><td>CO3</td><td colspan="4">Working of Series/Shunt/Compound DC Generators</td></tr>
<tr><td>CO4</td><td colspan="4">Various characteristics of DC machines</td></tr>
<tr><td>CO5</td><td colspan="4">Speed –torque characteristics of DC Machines</td></tr>
<tr><td colspan="7">The purpose of this course is to introduce to the students the basics of single phase and three phase Transformer, DC series, shunt and Compound motor/generator and to analyze their characteristics</td></tr>
<tr><td>List of Experiments:</td><td colspan="6">1. To perform Load test on a single-phase transformer.
2. To perform Open circuit and short circuit tests on a single-phase transformer.
3. To find the efficiency and voltage regulation of single-phase transformer under different loading conditions.
4. To perform parallel operation of two single-phase transformers.
5. To study the various connections of three-phase transformer.
6. To study the constructional details of direct current (DC) machine and to draw sketches of different components.
7. To measure armature and field resistance of direct current (DC) shunt generator and to obtain its open circuit characteristics.
8. To obtain load characteristics of direct current (DC) shunt generator.
9. To obtain load characteristics of direct current (DC) series generator.
10. To obtain load characteristics of direct current (DC) compound generator.
11. To draw speed-torque characteristics of direct current (DC) shunt/series/compound generator.
12. To study two/three/four point starters for DC machine.
13. To perform Swinburne's test (no load test) to determine losses of direct current (DC) shunt motor.</td></tr>
</table>

Course Title:	Electrical Measurement & Instrumentation Laboratory		L	T	P	Cr
Course Code:	ELE210		0	0	2	1
Course Outcome: After completion of course, the students should be able to	CO1	Various types of electromechanical measuring instruments.				
	CO2	Calibrate and use the Digital Energy Meter.				
	CO3	Measuring R,L,C.Using Bridges				
	CO4	Measurement of frequency using Wien's Bridge.				
	CO5	Usage of DSO for steady-state periodic waveforms produced by a function generator,				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1	L2	L3	L2	L2

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	1	-	-	1	1	1	3	3	1
CO2	3	-	2	-	2	-	-	-	3	-	-	2	3	1
CO3	3	3	-	3	3	1	-	-	3	2	1	-	3	2
CO4	3	2	3	2	-	1	-	-	2	2	-	3	3	1
CO5	3	2	3	-	3	1	-	-	2	-	1	2	3	1

List of Experiments:	1. Study of principle of operation of various types of electromechanical measuring instruments. 2. Determination of frequency, Amplitude, RMS Value, Average Value and phase angle using Cathode Ray Oscilloscope. 3. To calibrate and use the Digital Energy Meter. 4. Measurement of resistance using Wheatstone bridge. 5. Measurement of resistance using Kelvin's Bridge. 6. Measurement of self-inductance using Anderson's Bridge. 7. Measurement of capacitance using Schering Bridge. 8. Measurement of capacitance using Desauty's Bridge. 9. Measurement of frequency using Wien's Bridge. 10. To measure the unknown resistance with the help of Voltmeter and Ammeter. 11. Usage of DSO for steady-state periodic waveforms produced by a function generator, Selection of trigger source and trigger level, selection of time-scale and voltage scale, Bandwidth of measurement and sampling rate.

Course Title:	**Power System-I (Transmission and Distribution)**		**L**	**T**	**P**	**Cr**
Course Code:	**ELE217**		**3**	**0**	**0**	**3**
Course Objective:	This course provides a comprehensive understanding of the origin and development of power system and basics of transmission line, its construction and economic design.					
Course Outcome: After completion of course, the students should be able to	**CO1**	**Introduction to supply system and economy law**				
	CO2	**Conductors and Transmission Line Construction**				
	CO3	**Skin and proximity effect demonstration.**				
	CO4	**Transmission Line Parameters**:				
	CO5	**Transmission Line performance**				
Learning Outcomes:	After the completion of this course the participants would be able to basics of overhead and underground transmission line.					

Unit A	**Introduction: P**ower supply network, effect of voltage in conductor size, comparison of conductor volume in typical systems elementary high voltage DC transmission and its advantages and disadvantages. Structure of a power system: Bulk Power Grids and Micro-grids. **Supply System**: Introduction to Transmission and Distribution systems, Comparison between DC and AC systems for Transmission and Distribution, comparison of cost of conductors, choice of working voltage for transmission and distribution, economic size of conductors-Kelvin's law, Radial and mesh distribution networks, Voltage regulation.	
		10 Hours
Unit B	**Conductors and Transmission Line Construction**: Conductor materials; solid, stranded, ACSR, hollow and bundle conductors. Different types of supporting structures for overhead lines. Elementary ideas about transmission line construction and erection. Stringing of conductors, spacing, sag and clearance from ground, overhead line insulators, Concept of string efficiency. Phenomenon of corona, electric stress, corona discharge. **Transmission Line Parameters**: Introduction to line parameters, Resistance of transmission line, inductance of single-phasetwo-wire line, concept of G.M.D., Inductance of three-phase line, Use of bundled conductor, transposition of power lines, capacitance of 1-phase and 3-phase lines, effect of earth on capacitance of conductors. Double circuit lines, Skin and Proximity effect.	
		10 Hours
Unit C	**Performance of transmission lines**: Representation of short transmission line, medium length line (nominal T & II circuits), long length line by hyperbolic equations and equivalent T & II circuits. Power flow through transmission lines, ABCD constants, Voltage regulation.	
		10 Hours

Unit D	**Underground Cables**: Classification of cables based upon voltage and dielectric material, insulation resistance and capacitance of single core cable, dielectric stress, Capacitance of 3 core cables, methods of laying, heating effect, Maximum current carrying capacity, cause of failure, comparison with overhead transmission lines.
	10 Hours

Suggested Books:

1. Elgerd O.L. *Electrical Energy System Theory - An introduction* Tata McGraw-Hill Publication
2. Gupta B.R. *Power System Analysis & Design* Wheeler Publishing.
3. Nagrath I.J. and Kothari D.P. *Power System Analysis* Tata McGraw-Hill Publication
4. Stevenson Jr. W.D. *Elements of Power System Analysis* Tata McGraw-Hill Publication
5. Wadhwa C.L C*ourse in Electrical Power* New Age International Pvt. Ltd.

Course Title:	Electromagnetic Field Theory		L	T	P	Cr
Course Code:	ELE204		3	0	0	3
Course Objective:	This course provides a comprehensive understanding of electrostatics, Magnetostatics and development of Maxwell's equation and EM wave equations and their applications in transmission lines. It enables the students to understand the universal theoretical concepts in three-dimensional real world and find solution to problems related to electromagnetic wave propagation					
Course Outcome: After completion of course, the students should be able to	CO1	understand vector analysis, curl, gradient, divergence and laws of static electric field.				
	CO2	analyse steady and time varying magnetic field, basic laws, vector representation, steady state equation, Poynting Vector etc.				
	CO3	interpret EM wave propagation in homogeneous, conducting and dielectric mediums.				
	CO4	differentiate reflection & refraction of EM waves by perfect conductor, dielectric and insulator.				
	CO5	analyse Transmission line travelling & standing waves, characteristic impedance, reflection coefficient.				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L1, L2	L3,L5	L2	L2, L4

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	1	1	3	1	3	1	1
CO2	3	2	-	1	2	-	-	-	-	3	-	3	1	1
CO3	3	3	2	3	-	2	1	-	2	3	-	3	2	3
CO4	3	3	2	3	1	3	1	-	2	3	1	3	2	3
CO5	3	2	1	2	2	3	2	-	2	3	1	3	3	3

Unit A	**Review of Vector Analysis:** Vector analysis, Physical interpretation of gradient, divergence and curl; vector relations in other coordinate systems, integral theorems: divergence theorem, Stoke's theorem, Green's theorem and Helmholtz theorem, numerical problems.
	12 Hours

Unit B	**Electrostatics:** Introduction to fundamental relations of electrostatic field; Gauss's law and its applications; potential function; Field due to continuous distribution of charges; Equipotential surfaces; Divergence theorem; Poisson's equation and Laplace's equation, capacitance, electrostatic energy, Conditions at Boundary between dielectrics, Uniqueness theorem. **Magnetostatics:** Magnetic induction and Faraday's laws; magnetic Flux Density; magnetic field strength and magneto motive force; Ampere's work Law in the differential vector form; permeability; energy stored in a magnetic field ; ampere's force law; magnetic vector potential, Analogies between electric and magnetic field
	13 Hours
Unit C	**Maxwell's Equations and Time-Varying Fields:** Equation of continuity for time-varying fields, Inconsistency of Ampere's law, Maxwell's equations in integral and differential form for static and time-varying fields, conditions at a Boundary surface, Concept of Poynting vector, Poynting Theorem, Interpretation of E x H
	12 Hours
Unit D	**Electromagnetic Waves Propagation:** Solutions for free-space conditions; Uniform Plane Wave Propagation; Wave equations for a conducting medium; Sinusoidal time variations; Polarization; Conductors and Dielectrics; Direction Cosines; Reflection by Perfect Conductor-normal and oblique incidence, Perfect Dielectric-normal incidence, Perfect Insulator–Oblique incidence; Brewster angle, Reflection at a surface of Conductive medium, Surface impedance, wave impedance, velocities of propagation. **Transmission Lines:** Circuit representation of parallel plane transmission lines. Parallel plane transmission line with losses. Low loss RF and UHF transmission lines. Distortion less condition. Transmission line charts-impedance matching, Introduction to waveguides. Introduction to computational electromagnetic. Projects related to this course should be given to students(in groups) in order to promote team work and ethical values.
	13 Hours

Suggested Books:

1. Sadiku, Matthew NO. *Elements of electromagnetics*. Oxford university press, 2014.
2. Jordan, Edward C., and Keith G. Balmain. "Electromagnetic waves and radiating systems." (1968).
3. Kraus, John. *Electromagnetics*. McGraw-Hill, 1992.
4. Edminister, Joseph. *Schaum's outline of theory and problems of electromagnetics*. 1993.
5. Rao, NannapaneniNarayana. *Elements of engineering electromagnetics*. Prentice Hall, 1977.
6. Prasad, K. D., and Deepak Handa. *Antenna and wave propagation*. SatyaPrakashan, 2003.

Course Title:	Electrical Machines-II (Asynchronous and Special Purpose Machine)		L	T	P	Cr
Course Code:	ELE218		3	0	0	3
Course Objective:	Understand the basic principles of operation of rotating electric machines, their classification, and basic efficiency and performance characteristics.					
Course Outcome: After completion of course, the students should be able to	CO1	Fundamentals of AC machine windings				
	CO2	Polyphase Induction Machines				
	CO3	Starting Methods and Speed Control of induction motor				
	CO4	Single phase Induction motor working				
	CO5	Special Purpose Motors:				

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L2, L4	L2	L3	L3

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	1	1	1	-	-	1	2	1	-	3	3	1
CO2	3	3	-	2	-	1	-	-	2	-	-	-	3	1
CO3	3	1	2	3	1	-	1	-	2	1	1	3	3	1
CO4	3	-	2	-	-	1	-	1	2	1	-	2	3	1
CO5	2	2	3	1	1	1	-	-	2	1	-	2	2	1

Unit A

Fundamentals of AC machine windings: Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidaly distributed winding, winding distribution factor.

12 Hours

Unit B

Polyphase Induction Machines: Analogy between induction motor and transformer, production of rotating field in space distributed three-phase winding, constructional features, concept of slip and operation, rotor frequency, current and power, equivalent circuit, phasor diagram, torque-slip characteristics, effect of rotor circuit resistance, starting torque, crawling and cogging, cage motors(double cage and deep bar motor). Power flow diagram of practical induction motor, Determination of efficiency.

13 Hours

Unit C	**Starting Methods and Speed Control:** commonly used starting methods speed control of induction motor (i) control of speed of rotating field, (ii) control of slip speed. Effect of voltage injection in rotor circuit of slip ring induction motor. Motor tests for estimation of equivalent circuit parameters.(No-load and Blocked rotor test.)
	12 Hours
Unit D	**Single phase Motors:** Principle of operations, Double Revolving field theory, Equivalent circuit of single phase induction motor based on two revolving field theory, operation of, Split phase, induction motor. Capacitors motors, shaded pole motor, universal motor. **Special Purpose Motors:** Stepper Motors: construction, principle of operation and applications, Linear Induction Machines: construction, principle of operation and applications. Universal Motor: construction, principle of operation and applications.
	13 Hours

Suggested Books:

1. Fitzgerald A.E., Kingsley C. and Umans S.D. *Electric Machinery* 6th Edition, McGraw Hill
2. Langsdorff E.H. *Principles of A.C. Machines* McGraw Hill
3. Nagrath I.J. and Kothari D.P. *Electrical Machines* 4th Edition, Tata McGraw Hill,
4. Bimbhra P.S. *Electrical Machinery Khanna Publishers*
5. Say M G *Alternating Current Machines* 5th edition, Sir Isaac pitman& Sons Ltd.

Course Title:	Renewable Energy Sources and Management		L	T	P	Cr
Course Code:	ELE214B		3	0	0	3
Course Objective:	This course provides a comprehensive understanding renewable energy systems, their processing and analyses.					
Course Outcome: After completion of course, the students should be able to	CO1	acquire the knowledge of Global energy requirement and acquire an in depth knowledge about the energy conservation and Energy management.				
	CO2	gain the knowledge of MHD Generators and Thermo-Electric Generators				
	CO3	acquire the knowledge of PV Cells and solar power utilization.				
	CO4	gain the knowledge of electric power generation from wind power.				
	CO5	Understanding Fuel cells, principle of action, general description of fuel cells and **k**now the harnessing power from bio and other renewable sources				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L1, L2	L2	L1, L2	L2

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	-	1	-	1	2	1	-	2	1	-	2	2	1
CO2	3	3	3	1	2	3	-	2	2	-	3	2	3	3
CO3	2	3	3	-	2	3	3	-	3	1	-	2	3	3
CO4	3	3	3	1	2	3	3	1	2	-	3	2	3	3
CO5	2	2	-	-	1	2	3	2	3	1	3	2	3	1

Unit A

Introduction: Global energy requirement, Limitations of Conventional Energy sources, uses & growth of alternate energy sources, Basic schemes & application of direct energy conversion, Applications of carbon credit, Kyoto Protocol and oil crisis.

Energy Management: Principles of energy conservation and management: waste heat utilisation, heat pumps, industrial and commercial applications of heat pump. Energy Audit, energy conservation approach/technologies, co-generation, waste heat utilization, power factor improvement, regeneration methods, energy storage, efficient energy management, techniques, Energy management system in India.

13 Hours

Unit B	**MHD Generators:** Basic principle, gaseous conduction & Hall Effect, generator & motor effect, different types of MHD generators, practical MHD generators, applications & economic aspects. **Thermo-Electric Generators:** Thermoelectric effects, Thermo electric converters, figure of merit, properties of thermoelectric materials, brief description of construction of thermoelectric generators, applications & economic aspects.
	12 Hours
Unit C	**Photo Voltaic Effect & Solar Energy:** Photo Voltaic effect, different types of photoelectric cells, cell fabrication, characteristics of photovoltaic cells, conversion efficiency, solar batteries, solar radiation analysis, solar energy in India, solar collector, solar furnaces & applications.
	12 Hours
Unit D	**Alternate Sources:** Fuel cells, principle of action, general description of fuel cells, conversion efficiency, operational characteristics & applications. Low-level hydro plants, definition of low head hydropower, Choice of site, choice of turbines. Wind power, history of wind power, wind machines, theory of wind power, characteristics of suitable wind power sites, Biomass energy, conversion processes. Different biomass energy resources, electric equipment, precautions, and applications.
	14 Hours

Suggested Books:

1. Chakrabarti, A. *Energy Engineering and Management* PHI, 2013
2. Kashkari, Chaman. *Energy: Resources, Demand, and Conservation, with Special Reference to India*. New Delhi: Tata McGraw Hill Publishing Company, 1975.
3. R.A. Coormbe*An Introduction to Direct Energy Conservation*.
4. Kettani, M *Direct Energy Conversion*.
5. Loftness, Robert L. "Energy handbook." (1984).
6. Considine, Douglas M. "Energy technology handbook." (1977).
7. Rai, G. D. "Non-conventional energy resources." *Khpu Khanna, India* 369 (2004): 331-337.
8. Rao, S., and B. B. Parulekar. "Energy Technology: Non-conventional, renewable and conventional." *Khanna Publication, 3rd* (2012).
9. Ter-Gazarian, Andrei G. *Energy storage for power systems*. No. 6. Iet, 1994.

Course Title:	Electrical Estimation and Costing Laboratory		L	T	P	Cr
Course Code:	ELE470A		0	0	6	3
Course Outcome: After completion of course, the students should be able to	**CO1**	Understand basic concept of wiring system and standard related to wiring system and knowledge regarding estimation, costing and purchasing.				
	CO2	understand and describe the basic term, general rules, circuit design procedure, wiring design for domestic and industrial installationand describe the basic term, general rules, circuit design procedure, wiring design for domestic and industrial installation				
	CO3	prepare details estimation and costing of domestic, commercial and industrial electrical installation as per IE Rules and test domestic, commercial and industrial installation as per standard				
	CO4	Prepare detail estimation and costing for single and three-phase service connection installation of service connection and prepare estimation and costing of overhead & underground transmission and distribution line.				
	CO5	Prepare estimate and costing of repair and maintenance of electrical equipment and products				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L1, L2	L2	L2	L2

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	2	-	-	3	2	2	-	1	1	2	-	2	2	2
CO2	2	-	3	3	-	2	-	3	-	2	2	2	3	3
CO3	3	3	3	3	2	2	2	2	-	2	2	3	3	3
CO4	2	3	3	2	2	1	1	3	2	-	3	2	3	3
CO5	2	-	2	-	2	3	-	2	2	2	3	2	1	3

List of Experiments:	1. To study Indian electricity rules. 2. To carryout wiring diagram of residential building, Educational Institute and Industry. Giving selection of appropriate wiring, list materials and accessories for given project. 3. To study the design consideration of Panel Boards. 4. To study the design consideration of various electrical systems: a. 3 phase four wire distribution systems b. Earthing. 5. To estimate the cost of a domestic installation (Residential building, laboratory room or Drawing hall etc.) with concept of illumination design. TERI (The Energy Research Institute) recommendations on lighting schemes 6. To estimate the cost of industrial installation (Workshop, agriculture, flour mill etc.). 7. To estimate the cost of overhead service connection (Single phase and three phase). 8. To estimate the cost of underground service connection (single phase and three phase). 9. To estimate the cost of overhead, 440 V, 3-phase, 4 wire or 3 wire distribution line. 10. To estimate the cost of underground distribution line. 11. To estimate the cost of any one electrical appliance. 12. To estimate the cost of repairs and maintenance of domestic appliance such as heater, electric iron, fans, washing machine, geyser, AC etc. 13. To design & fabricate single phase transformer 14. To study various types of light sources and lighting schemes. 15. To make wiring diagrams of motor control circuits for starting of a. 3 phase induction motor b. Synchronous motor

Course Title:	Signal and Systems		L	T	P	Cr
Course Code:	ELE330		3	0	0	3
Course Outcome: After completion of course, the students should be able to	CO1	interpret signals, convolution and learn various properties.				
	CO2	to familiarize the concepts of transform based continuous time and discrete time analysis of signals and systems.				
	CO3	be conversant in Fourier Series, Fourier Transform along with their basic properties				
	CO4	analyse sampling, restructuring, sampling theorem, aliasing, signal processing.				
	CO5	study Laplace and Z-transform, their basic properties, region of convergence, inverse Laplace and Z-transform, rational system functions.				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L2	L3, L4	L4, L5	L3, L4

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	-	-	1	3	1	2	1	2
CO2	3	3	2	1	1	-	-	-	1	2	1	2	2	2
CO3	3	3	3	2	2	1	-	-	-	2	1	-	3	3
CO4	3	3	3	2	3	3	1	1	3	2	3	2	3	3
CO5	3	2	2	1	1	2	-	-	1	2	3	-	2	2

Unit A	**Classification of Signals And Systems:** Classification of Signals: Continuous time signals , Discrete-time signals, Periodic and Aperiodic signals , Even and odd signals, Energy and power signals ,Deterministic and random signals ,Complex exponential and Sinusoidal signals .Unit step, Unit ramp, Unit impulse ,Representation of signals in terms of unit impulse .Classification of Systems: Continuous time systems, Discrete-time systems , Linear system, Time Invariant system, causal system ,BIBO system ,Systems with and without memory ,LTI system.
41	**5 Hours**

Unit B	**Analysis of Continuous-Time Signals**: Fourier series: Representation of Continuous time Periodic signals , Trigonometric and exponential, Symmetry conditions, Properties of Continuous-time Fourier series, Parseval's relation for power signals, Frequency spectrum. Fourier transform: Representation of Continuous-time signals, Properties of Continuous-time Fourier transform , Parseval's relation for energy signals ,Frequency spectrum, Analysis of LTI system using Fourier methods. **LTI Continuous Time System**: System modelling: Solution of Differential equation with initial conditions, Zero state response and Zero input response, impulse response ,Frequency response , Convolution ,Analysis and characterization of LTI system using Laplace transform.
	10 Hours
Unit C	**Analysis Of Discrete-Time Signals And Systems**: Representation of sequences, Discrete-Time Fourier Transform (DTFT) , Discrete Fourier Transform (DFT) and its properties, Solution of linear constant coefficient difference equations with initial conditions, Zero state response and Zero input response– impulse response , Convolution sum , Frequency response.
	15 Hours
Unit D	**LTI DT System Characterization and Realization**: Unilateral and Bilateral Z transforms and its properties, Inverse Z transform: Power series expansion and Partial fraction methods , Analysis and characterization of DT system using Z transform, Realization of structures for DT systems , Direct form-I, Direct form II, , Parallel, Cascade forms **Sampling and Reconstruction** The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.
	15 Hours

Suggested Books:

1. Oppenheim Allan V., Wilsky S. and Nawab S.H., "**Signals and Systems**", Pearson Education.
2. RawatTarun Kumar , "**Signal and Systems**", First edition 2010, Oxford Press
3. Edward W. Kamen& Heck Bonnie's, "*Fundamentals of Signals and Systems*", Pearson Education.
4. Haykins Simon, "*Communication Signals & System*", John Wiley & Sons.
5. Hsu H. P., RanjanRakesh, Schaum'sOutlines , "*Signals and Systems*", Tata McGraw Hill.
6. Salivahanan S., Vallavaraj A., Gnanapriya C., "*Digital Signal Processing*", McGraw Hill International.

Course Title:	Transducer and Signal Conditioning	L	T	P	Cr
Course Code:	ELE318A	3	0	0	3

Course Outcome: After completion of course, the students should be able to		
	CO1	exposed to various sensors and transducers for measuring physical quantities
	CO2	familiar with the specifications of transducers and their application.
	CO3	exposed to advancements in sensor technology and able to identify or use a transducer for a specific measurement application.
	CO4	understand signal conditioning circuits and basic telemetry
	CO5	identify or use CRO for specific measurement application.

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L2, L4	L2,L4	L5, L6	L6	L5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	-	2	-	-	2	-	-	1	2	2	-	-	3
CO2	3	3	2	-	3	2	1	-	1	-	2	2	1	3
CO3	3	-	3	3	3	-	1	1	-	2	3	2	1	3
CO4	3	3	3	3	3	2	-	-	1	2	3	-	1	2
CO5	3	-	2	-	-	2	-	-	1	-	2	-	-	2

Unit A	**Introduction:** Measurement systems, Basic electronic measuring system, advantage of electric transducers Transduction principles, Classification of transducers, General transducers characteristics, Criteria for transducer selection, characteristics of transducers: input characteristics, transfer characteristics, output characteristics **Resistive Transducers:** Principles of operation, construction, theory, advantages and disadvantages, applications of Potentiometers, strain gauges, (metallic and semiconductor type), Resistance Thermometer, Thermistor. **Inductive Transducers:** Types of Inductive transducer, Principles of operation, construction, Advantages & disadvantages and applications. Various variable Inductive Transducers: LVDT Linear variable differential transformer (LVDT), advantages & disadvantages of LVDT. Uses of LVDT, Rotary Variable Differential Transformer (RVDT), applications **Capacitive Transducers:**Types of capacitive transducer, Principles of operation, construction, theory, advantages and disadvantages and applications, of capacitive transducers based upon familiar equation of capacitance **Elastic Transducers:** Spring bellows, diaphragm, bourdon tube – their special features and application
	14 Hours
Unit B	**Active Transducers:** Principle of operation, construction, theory, advantages and disadvantages and applications of following transducers: Thermocouple, Piezo-electric transducer, Magnetostrictive transducer, Hall effect transducer, Photo-voltaic transducer and electrochemical transducer. **Other Transducers:** Optical transducers: photo-emissive, photo-conductive and Photo-voltaic cells, Digital **Opto–Electronic Transducers:**photoconductive cells, semiconductor photodiode, Phototransistors, Optical encoder, Shaft encoder. Feedback fundamentals, introduction to Inverse transducer.
	12 Hours
Unit C	**Measurement Using Transducers:** Motion, Force and Torque measurement, fundamental standards, standard, relative displacement, transnational and rotational relative; velocity transducers: rotational relative, transnational and rotational relative; acceleration measurements: seismic and absolute display, Accelerometers: Standards and Calibration, Basic methods of force measurement, Characteristics of elastic force transducer, Torque Measurement of rotating Shafts, dynamometers, Pressure measurement: standards and Calibration, Basic Methods of Pressure measurement, Thermocouple Vacuum Gauge, Pirani Gauge, Ionization Type, Vacuum Gauges, Elastic Transducers, High Pressure Measurement, Low Pressure (Vacuum) measurement, Flow measurement Local flow velocity, Magnitude and direction Gross volume flow rate, Gross Mass flow rate, Turbine Meters Effect.
	12 Hours
Unit D	**Signal Conditioning:** Concept of signal conditioning, Op-amp circuits used in instrumentation, Instrumentation amplifiers, analog-digital sampling, introduction to A/D and D/A conversion, signal filtering, averaging, correlation, Interference, grounding, and shielding. Basic telemetry system. **Oscilloscopes:** Introduction, Basic principles, CRT features, Block diagram and working of each block, Typical CRT connections, study of various stages in brief, high-frequency CRO considerations, measurement of phase &frequency, electrostatic deflection, dual trace & dual beam oscilloscope, Sampling and storage oscilloscope, Introduction to DSO.
	12 Hours
Suggested Books:	

1. Murty D V S, "*Transducers & Instrumentation*", PHI, New Delhi, 2000.
2. Sawhney A K, "*Electrical and Electronics Measurements and Instrumentation*", DhanpatRai and Sons,New Delhi, 2000.
3. Kalsi H S, "*Electronic Instrumentation*", Tata McGraw Hill, New Delhi, 4th Ed., 2001.
4. Patranabis D, "*Sensors and Transducers*", PHI, New Delhi, 2003.
5. Doebelin Ernest O, "*Measurement Systems: Application and Design*", Tata McGraw Hill Ltd., New Delhi, 2004.

Course Title:	Digital Electronics	L	T	P	Cr
Course Code:	ELE314	3	0	0	3

Course Outcome: After completion of course, the students should be able to		
	CO1	Understand concepts of combinational and sequential circuits
	CO2	Analyze the synchronous and asynchronous logic circuits.
	CO3	Understand concepts of memory, programmable logic and digital integrated circuits.
	CO4	Design Combinational and sequential systems.
	CO5	RTL, DCTL, DTL, TTL, ECL, CMOS and its various types

Unit A	**Number System and Binary Code :** Introduction, Binary, Octal, Hexadecimal & some nonstandard Number :- Conversions, Addition, Subtractions, Multiplication, Division, Weighted- Non weighted codes, Signed - unsigned numbers, Binary Subtractions using 1's and 2's compliment, ASCII code, Excess 3 code, Grey code, BCD code and BCD additions & BCD Subtractions.
	12 Hours
Unit B	**Minimization of logic function :**Review of gates: - OR, AND, NOT, NOR, NAND, EX-OR, EXNOR, Universal gates, Basic theorem of Boolean algebra, Sum of Products and Product of Sums, canonical form, Minimization using: - Boolean algebra, K-map and Q-M method.
	14 Hours
Unit C	**Combinational Circuits :** Introduction, Combinational circuit design, Encoders, decoders, Adders, Sub tractors and Code converters, Parity checker, seven segment display, Magnitude comparators. Multiplexers, De-multiplexer, Implementation of Combinational circuit using MUX & De-MUX. **Sequential Circuits :** Introduction, flip flops, Clocked flip-flops, SR, JK, D, T and edge-triggered flip-flops, Conversions of Flip flops, Shift Registers, Type of Shift Registers, Ring Counter, Twisted Ring Counter, Counters, Counter types, counter design with state equation and state diagrams.
	10 Hours
Unit D	**D/A and A/D Converters:** Introduction, Weighted register D/A converter, binary ladder D/A converter, steady-state accuracy test, monotonicity test, D/A accuracy and resolution, A/D converter:- Simultaneous, Counter type, Continuous, Successive approximation, Single and dual slope A/D converter, A/D accuracy and resolution. **Semiconductor Memories** Introduction, Memory organization, Classification and characteristics of memories, Sequential memories, ROMs, R/W memories, Content addressable memories, PLA and PAL. **Logic Families:** RTL, DCTL, DTL, TTL, ECL, CMOS and its various types, Comparison of logic families.
	10Hours
Suggested Books:	

1. Morris Mano, "*Digital Design*", Prentice Hall of India Pvt. Ltd
2. Donald P.Leach&Albert Paul Malvino,"*Digital Principles and Applications*", 5 ed., TataMcGraw Hill Publishing Company Limited, New Delhi, 2003.
3. Jain R.P., "*Modern Digital Electronics*", 3ed., Tata McGraw–Hill publishing Company limited, New Delhi, 2003.
4. Thomas L. Floyd, " *Digital Fundamentals*", Pearson Education, Inc, New Delhi, 2003
5. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, "*Digital System -Principles and Applications*", Pearson Education.

<table>
<tr><td>Course Title:</td><td colspan="2">Digital Electronics Laboratory</td><td>L</td><td>T</td><td>P</td><td>Cr</td></tr>
<tr><td>Course Code:</td><td colspan="2">ELE331</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td rowspan="5">Course Outcome:
After completion of course, the students should be able to</td><td>CO1</td><td colspan="5">Verification of the truth tables of TTL gates</td></tr>
<tr><td>CO2</td><td colspan="5">Verify the NAND and NOR gates as universal logic gates.</td></tr>
<tr><td>CO3</td><td colspan="5">Half adder/ Full adder realization</td></tr>
<tr><td>CO4</td><td colspan="5">Multiplexer/ DE multiplexer Realization</td></tr>
<tr><td>CO5</td><td colspan="5">Introduction to flip-flops</td></tr>
<tr><td colspan="7">To understand the practicability ofDigital Electronics Laboratory, the list of experiments to be performed in the laboratory is given below</td></tr>
<tr><td>List of Experiments:</td><td colspan="6">1. Verification of the truth tables of TTL gates, e.g., 7400, 7402, 7404, 7408, 7432, 7486.
2. Verify the NAND and NOR gates as universal logic gates.
3. Verification of the truth table of the Multiplexer 74150.
4. Verification of the truth table of the De-Multiplexer 74154.
5. Design and verification of the truth tables of Half and Full adder circuits.
6. Design and verification of the truth tables of Half and Full subtractor circuits.
7. Design and test of an S-R flip-flop using NOR/NAND gates. a) Verify the truth table of a J-K flip-flop (7476) b) Verify the truth table of a D flip-flop (7474)
8. Operate the counters 7490, 7493 and 74194. Verify the frequency division at each stage and with a low-frequency clock (say 1 Hz) display the count on LEDs.
9. Verify the truth table of decoder driver 7447/7448. Hence operate a 7 segment LED display through a counter using a low-frequency clock.
10. Repeat the above with the BCD to Decimal decoder 7442 and an array of LEDs
11. Design and test D/A converter using R-2R Ladder Network 12. Study and test of A/D converter.</td></tr>
</table>

Course Title:	Power Electronics	L	T	P	Cr
Course Code:	ELE306A	3	1	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	Acquire knowledge about fundamental concepts and techniques used in **power electronics** switches, their properties and characteristics.
	CO2	**Thyristor Turn on and Turn off methods, Various overvoltage and over current protection techniques.**
	CO3	Analyse and design of various single phase and three phase AC-DC converters, AC-AC converters **power** converter circuits and understand their applications
	CO4	analysis and design of inverters which consist of half and full bridge, single and three phase etc.
	CO5	Analysis and Design of Buck Boost Chopper circuit, Classification and commutation techniques.

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L2, L4	L2	L3	L3

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	1	3	1	1	1	-	-	1	2	1	-	2	3	1
CO2	2	3	-	2	-	1	-	-	2	-	-	-	-	1
CO3	3	2	2	3	1	-	1	-	1	1	1	3	3	1
CO4	2	2	1	-	-	1	-	1	2	1	-	2	3	1
CO5	2	-	-	1	1	1	-	-	2	1	-	1	2	1

Unit A

Thyristors and their characteristics: Introduction to Thyristor family, V-I characteristics of silicon-controlled rectifier (SCR), gate turn-off thyristor (GTO), Bidirectional diode for alternating current (DIAC) and Bidirectional, Triode for Alternating Current (TRIAC). Principle of operation of silicon-controlled rectifier (SCR). Two transistor analogy. Turn on methods of a thyristor Switching characteristics of thyristors during tum-on and turn-off. Gate characteristics. Firing of thyristors. Gate triggering circuits. Series and parallel operation of silicon-controlled rectifiers (SCR) and their triggering circuits. Thyristor specifications; such as latching current and holding current, critical rate of rise of off-state voltage (dv/dt) and critical rate of rise of on-state current (di/dt) etc. Protection of SCR from over voltage and overcurrent. Snubber circuits. Power dissipation.

Thyristor commutation techniques: Self-commutation by resonating the load (Class A), Self-commutation by LC circuit (class B), Complementary commutation (class C), Auxiliary commutation (class D), External pulse commutation (class E), AC Line commutation (class F).

14 Hours

Unit B	**Phase controlled techniques:** Introduction to phase angle control. Single phase half wave controlled rectifiers. Single phase half controlled and fully controlled bridge rectifiers. Three phase full controlled bridge rectifiers. Effect of resistive, inductive and resistive cum inductive loads. Basic circuit and principle of operation of Dual Converter, circulating current mode and non-circulating current mode of operation. Applications of rectifiers and dual converters to speed control of DC motor drives. Introduction to AC regulators, types and applications.
	13 Hours
Unit C	**Inverters:** Introduction & Classification of inverter. Operating principle, Single phase half bridge voltage source inverters, Single phase full bridge inverter. Modified McMurray half-bridge and full-bridge inverter. Three-phase bridge inverter. Voltage control (Pulse-width modulation (PWM) control etc.) and reduction of harmonics in the inverter output voltage. Series inverter.
	14 Hours
Unit D	**Choppers:** Introduction of chopper, Basic chopper classification, Basic chopper operations. Control strategies, Chopper configuration, voltage commutated chopper, Current commutated chopper, Load commutated chopper
	14 Hours

Suggested Books:

(ii) Bimbhra, P.S., "*Power Electronics*", Khanna Publishers.

(iii) Singh M.D. and Khanchandani K.B., "*Power Electronics*", Tata McGraw Hill Publishing Company limited.

(iv) Rashid M.H., "*Power Electronics, Circuits Devices and Applications*", Prentice Hall, India.

(v) Sen, P.C., "*Power Electronics*", Tata McGraw Hill Publishing Company limited.

(vi) Bhattacharya S.K. and Chatterji, S., "*Industrial Electronics and Control*", New Age international Publications (P) Ltd, New Delhi.

(vii) Dubey, G.K, "*Fundamentals of Electrical Drives*", Narosa.

(viii) Philip T. Krein, "*Elements of Power Electronics*",Oxford University Press,2017

Course Title:	**Power Electronics Laboratory**		L	T	P	Cr
Course Code:	**ELE310**		**0**	**0**	**2**	**1**
Course Outcome: After completion of course, the students should be able to	**CO1**	Identify relevant information to supplement to the Power Electronics course.				
	CO2	Set up testing strategies and select proper instruments to evaluate performance characteristics of Power devices and power electronics circuits and analyze their operation under different loading conditions.				
	CO3	Practice different types of wiring and devices connections keeping in mind technical, economical, safety issues.				
	CO4	Realize the limitations of computer simulations for verification of circuit behaviour, apply these techniques to different power electronic circuits and evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.				
	CO5	Prepare professional quality textual and graphical presentations of laboratory data and computational results, incorporating accepted data analysis and synthesis methods, mathematical software, and word-processing tools.				

To understand the practicability of**Power Electronics Laboratory**, the list of experiments to be performed in the laboratory is given below

List of Experiments:

1. To analyse principle of operation of SCR, plot V-I characteristics and study the effect of gate triggering on turning on of SCR.
2. To draw V-I characteristics of an UJT and to use UJT as relaxation oscillator.
3. To study the effect of free-wheeling diode on power factor for single-phase half-wave rectifier with R-L load.
4. To plot waveforms for output voltage and current, for single-phase full-wave, fully controlled bridge rectifier, for resistive and resistive cum inductive loads.
5. Study of the microcontroller based firing control of a bridge converter.
6. To study three phase fully controlled bridge converter and plot waveforms of output voltage, for different firing angles.
7. Analyses of Jones chopper or any chopper circuit to check the performance.
8. Analyses of Microcontroller based thyristorised speed control of a D.C. Motor.
9. Analyses of Microcontroller based speed Control of three phase induction motor using thyristors.
10. Analyses of series inverter circuit and to check its performance.
11. Analyses of a single-phase cyclo-converter.
12. To check the performance of a McMurray half-bridge inverter

Course Title:	Power System-II (Stability and Fault Analysis)		L	T	P	Cr
Course Code:	ELE342A		3	1	0	4
Course Outcome: After completion of course, the students should be able to	**CO1**	Acquire the knowledge of Modelling of sysncheous motor, Transforfer Load etc, Single line diagram representation. Per unit representation.				
	CO2	Analysis of various Symmetrical and Unsymmetrical Faults. Transient Phenomena, and Traveling Waves in power system				
	CO3	**Analysis of stability of power system.**				
	CO4	**Acquire the knowledge of Neutral Grounding.**				
	CO5	**Understanding Power flow analysis of a complex power system**				

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L2, L4	L2	L3	L3

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	1	2	1	2	1	-	-	3	2	1	-	3	3	1
CO2	2	3	-	2	-	1	-	-	1	-	-	-	3	1
CO3	3	1	1	3	1	-	1	-	2	1	1	3	3	1
CO4	3	-	2	-	-	1	-	1	2	1	-	2	3	1
CO5	2	2	3	1	1	1	-	-	2	1	-	2	2	1

Unit A

System Modelling: System modeling of synchronous machines, transformers, loads etc, per unit system, single line diagram of electrical networks, single phase impedance diagrams, line reactance diagrams, Formulation of impedance and admittance matrices for the electrical networks

14 Hours

Unit B

Fault Analysis: Symmetrical Component transformation, construction of sequence networks of synchronous machines, transmission lines. Unsymmetrical Line-to-ground (LG), Line-to line (LL), double line to ground (LLG) faults using symmetrical components.

Transients in Power Systems: Transient electric phenomenon, travelling waves, reflection & refraction of waves with different line termination, protection against dangerous pressure rises.

13 Hours

Unit C	**Stability of Power System:** Concepts of stability, power angle characteristics of synchronous, steady state and transient stability swing waves. **Grounding:** Grounded & Ungrounded neutral systems, solid grounding, resistance grounding, reactance grounding. Voltage transformer earthing. Harmonic suppressors, grounding practice, grounding of sub-station.
	14 Hours
Unit D	**Incidence and Network Matrices:** Network graph, various incidence matrices, generalized element representation, primitive network and primitive network matrices, formation of various network matrices by Direct Inspection and singular transformations, interrelations between various incidence matrices and network **Load-Flow Studies:** Introduction, importance of load flow studies, classification of buses, load flow equations, iterative methods, computer algorithms and load flow solutions using Gauss Seidel and Newton Raphson load flow solutions, comparison of load flow solution methods.
	14 Hours

Suggested Books:

1. Elgerd O.I., "*Electric Energy Systems Theory*", Tata McGraw Hill
2. Nagrath I.J., Kolthari D.P., "*Modern Power System Analysis*", Tata McGraw Hill
3. Stevenson W.D., "*Elements of Power System Analysis*", McGraw Hill
4. Nagrath I.J. and Kothari D.P.," *Power System Engineering*", Tata McGraw Hill
5. Chakrabarti A., Soni, M.L. Gupta P.V. and Bhatanagar U.S., "*A Textbook on Power System Engineering*", DhanpatRai and Co
6. Deshpande M.V., "*Switchgears and Protection*", Tata McGraw Hill.
7. Wadhawa C.L. , "*A Course in Electrical Power*", New Age international Pvt. Ltd
8. Gupta B.R., "*Power System Analysis & Design*", Wheeler Publishing

Course Title:	DESIGN AND SOFTWARE LABORATORY		L	T	P	Cr
Course Code:	ELE317		1	0	3	2
Course Outcome: After completion of course, the students should be able to	CO1	get a thorough knowledge of MATLAB				
	CO2	**Design** PCB and layout				
	CO3	apply conceptual things to real-world electrical and electronics problems and applications				
	CO4	Relate the software architectural styles to the suitable applications.				
	CO5	Have the knowledge of PC based data acquisition				

To understand the practicability of **DESIGN AND SOFTWARE LABORATORY**, the list of experiments to be performed in the laboratory is given below

List of Experiments:

1. To study the various toolboxes and environment of MATLAB/PSAT/PWSS/ETAP.
2. To Draw the Point, Line, Circle and Ellipse using MATLAB
3. Write a MATLAB Program to perform various operation of higher order Matrix.
4. Write the transfer function of a 1st order system using MATLAB and find the transient response.
5. Design of Control Systems using MATLAB and SIMULINK.
6. PCB design and layout
7. Introduction to PC based data acquisition
8. Study of Sensors and signal conditioning circuits.

Sensors and signal conditioning circuits, Electronic system design, Analog system design, Interfacing of analog and digital systems, Embedded systems, Electronic system design employing microcontrollers, CPLDs, and FPGAs, PCB design and layout; System assembly considerations.

Group projects involving electronic hardware (Analog, Digital, mixed signal) leading to Implementation of an application.

Course Title:	Industrial Training-I	L	T	P	Cr
Course Code:	ELE350	0	0	0	2

Course Outcome: After completion of course, the students should be able to		
	CO1	implement the project requiring individual and teamwork skills
	CO2	correlate the theoretical concepts with the real life industrial environment.
	CO3	gather and analyze the scientific information
	CO4	communicate their work effectively through writing and presentation

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4
RBTL No.	L3	L4	L4	L5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	-	2	2	-	-	3	3	3	-	3	3	1
CO2	3	2	3	3	3	3	2	2	2	3	1	3	3	1
CO3	3	3	2	3	-	2	2	-	1	3	-	3	3	3
CO4	1	-	1	1	1	-	-	-	1	3	1	3	1	3

Objective of the training programme is to

1. Enrich the students with a basic understanding of the Electrical Engineering, towards developing a holistic perspective to understand various practical issues and latest trends in the field.
2. Familiarize and provide “hands-on” training experience with the requisite simulation, design, and analytical tools and techniques.
3. Achieve a long-term goal of transforming themselves into a brilliant blend of theoretician and practicing engineer.
4. Introduce the way of troubleshooting various engineering faults related to respective fields.
5. Make the students able to present work in written, oral or formal presentation formats.

NOTE: At the end of the examination of 4th Semester the students will undergo compulsory summer training for a period of 4 weeks. Every student will submit the Summer Training Report within two weeks from the start of teaching for 5th Semester.

Course Title:	Power System III (Switchgears & Protection)		L	T	P	Cr
Course Code:	ELE337		3	1	0	4
Course Outcome: After completion of course, the students should be able to	**CO1**	Acquaint with the concept of power system, different types of switchgear equipment's like circuit breakers and relays.				
	CO2	Design the ratings for fuses according to the requirement				
	CO3	Conceptualize various protection schemes, various power system components like alternators, transformers and bus-bars				
	CO4	Access the results obtained by solving symmetrical and unsymmetrical fault studies on the power system networks and design the ratings of the circuit breaker				
	CO5	Understand protection of different electrical equipment's				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L3	L4	L6	L2

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	-	1	-	1	-	-	3	1	-	1	2	3	2
CO2	3	1	3	1	1	1	1	-	1	1	1	1	3	1
CO3	3	3	2	-	2	1	1	-	1	1	-	1	1	2
CO4	3	3	-	1	-	1	-	-	1	1	1	-	2	2
CO5	3	-	1	-	1	-	-	1	1	-	1	1	3	2

Unit A

Sub-Station: Types, Main equipment in Substation, substation layout, Bus bar-arrangements.

Isolators and Fuses: Isolating switches functions, Types, Rating and operation. Fuse-types, Rating, Selection, theory and characteristics, applications

14 Hours

Unit B	**Circuit Breakers:** Need for Circuit Breakers, Arc phenomenon, Theory of Arc Interruption, Recovery Voltage and Restriking Voltage, Various Types of Circuit Breakers. Principles and Constructional Details of Air Blast, Minimum Oil, SF6, Vacuum Circuit Breakers etc. **Protective Relays:** Introduction, classification, constructional features; and Characteristics of Electromagnetic, Induction, Thermal, Overcurrent relays, Directional relays, Distance relays, Differential, Translay, Negative sequence relay, introduction to static and up-based relays.
	13 Hours
Unit C	**Protection of Feeders:** Time graded protection, Differential and Distance protection of feeders, choice between Impedance, Reactance and Mho relays, Elementary idea about carrier current protection of lines. **Protection of Generators and Transformers:** Types of faults on alternator, Stator and rotor protection, Negative sequence protection, Loss of excitation and overload protection. Types of fault on transformers, percentage differential protection, Gas relays.
	14 Hours
Unit D	**Protection against overvoltage and earthing:** Ground wires, Rod gap, Impulse gap, Valve type and Metal Oxide Arresters, Line Arrester/Surge Absorber. Ungrounded neutral system, Grounded neutral system and Selection of Neutral Grounding.
	14 Hours

Suggested Books:

1. Wadhawa C.L. , "*A Course in Electrical Power*", New Age internationalPvt. Ltd
2. Badri Ram and Vishwakarma D.N., "*Power system Protection and Switchgear*", Tata McGraw Hill
3. *Deshpande M.V., "Switchgears* and Protection", Tata McGraw Hill
4. Nagsarkar T.K. &Sukhija M. S., "*Power System Analyses*",Oxford University Press,2014
5. Rao S., "*Switchgear and Protection*", Khanna Publishers
6. Chakrabarti A., Soni, M.L. Gupta P.V. and Bhatanagar U.S., "*A Textbook on Power System Engineering*", DhanpatRai and Co.

Course Title:	Control System	L	T	P	Cr
Course Code:	ELE338	3	1	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	Acquire the basic knowledge of control engineering and its scope
	CO2	Analyze the mathematical model of a system and determine the response of different order systems for standard inputs.
	CO3	Solve the steady state and transient analysis of a system for standard inputs.
	CO4	Analyze the stability analysis of a system
	CO5	Analyze closed loop control design problems, PID controller and compensation.

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L4	L5	L4	L4

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	3	3	2	2	-	-	-	1	2	2	2	3	2
CO2	3	3	2	3	3	3	-	1	2	-	3	-	3	2
CO3	3	2	3	2	2	2	-	-	3	3	2	2	3	2
CO4	2	2	2	2	3	3	-	1	2	-	3	-	3	2
CO5	3	3	3	2	2	1	-	-	1	2	-	2	3	2

Unit A

Introductory Concepts: Plant, Systems, Servomechanism, regulating systems, disturbances, Open loop control system, closed-loop control systems, linear and non-linear systems, time variant and invariant, continuous and sampled-data control systems, Block diagrams, some illustrative examples.

Modelling of Control System: Formulation of equation of linear electrical, mechanical, thermal, pneumatic and hydraulic system, electrical, mechanical analogies. Use of Laplace transforms, Transfer function, concepts of state variable modelling. Block diagram representation, signal flow graphs and associated algebra, characteristics equation.

		14 Hours
Unit B	**Time Domain Analysis**: Typical test–input signals, Transient response of the first and second order systems. Time domain specifications, Dominant closed-loop poles of higher order systems. Steady state error and coefficients, pole-zero location and stability, Routh-Hurwitz Criterion. **Root Locus Technique:** The extreme points of the root loci for positive gain. Asymptotes to the loci, Breakaway points, intersection with imaginary axis, location of roots with given gain and sketch of the root locus plot.	
		13 Hours
Unit C	**Frequency Domain Analysis**: Closed loop frequency response, Bode plots, stability and loop transfer function. Frequency response specifications, Relative stability, Relation between time and frequency response for second-order systems. Log. Magnitude versus Phase angle plot, Nyquist criterion for stability Introduction to P, I, D, PI, PD,PID Controllers, Digital implementation of controllers. **Compensation**: Necessity of compensation, series and parallel compensation, compensating networks, applications of lag and lead-compensation.	
		14 Hours
Unit D	**Variable Analysis:** Concept of state, state variable and state model, state models for linear continuous-time systems, diagonalization solution of state equations, concept of controllability and observability, Discrete-time systems. Pole-placement by state feedback Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems. **Control System Components**: Error detectors–potentiometers and synchros, servo motors, A.C. and D.C. techno generators, Magnetic amplifiers.	
		14 Hours

Suggested Books:

1. Nagrath I.J. and Gopal M., "*Control System Engineering*", Wiley Eastern Ltd
2. Ogata K., "*Modern Control Engineering*", Prentice Hall
3. Kuo B. C., *"Automatic Control System*", Prentice Hall
4. Dorf Richard C. and Bishop Robert H., "*Modern Control System*", Addison –Wesley, Pearson New Delhi

Course Title:	Control System Laboratory	L	T	P	Cr
Course Code:	ELE339	0	0	2	1
Course Outcome: After completion of course, the students should be able to	CO1	analyse the performance of various controllers			
	CO2	analyse the mathematical model of a system and determine the response of different order systems.			
	CO3	solve the steady state and transient analysis of a system.			
	CO4	Obtain the characteristics of Thermocouple			
	CO5	be competent in using MATLAB software to analyse closed loop control design problems design compensating networks.			

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L2, L4	L4	L4	L2	L6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO 4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2
CO1	3	2	2	-	1	1	-	-	1	1	2	2	3	2
CO2	3	2	2	-	2	-	-	-	1	-	2	3	1	2
CO3	2	2	3	1	2	-	-	-	-	1	2	2	2	2
CO4	1	2	2	3	2	1	-	-	1	-	2	3	1	1
CO5	1	2	3	1	2	-	-	-	-	1	2	2	2	2

List of Experiments:	1. Experiment to analyse D.C. position control system. 2. Experiment to analyse light intensity control using P, I, D & PID controller. 3. Experiment to perform D.C. motor speed control. 4. Experiment to use ON/OFF temperature controller. 5. Experiment to analyse Temperature control system. 6. Experiment to analyse Compensation design. 7. Experiment to analyse relay control system. 8. Experiment to use Potentials metric Error Detector. 9. Experiment to analyses synchros. 10. Experiment to measure the displacement using LVDT. 11. Experiment to measure the temperature using RTD. 12. Experiment to measure the temperature using Thermocouple. 13. Experiment to study the voltage induced using photo transistor, photodiode. 14. Write a program in MATLAB to find poles and zeros of transfer function and show poles as zeros in s-plane. 15. Write a program in MATLAB to draw unit step, ramp and parabolic response of second-order system. 16. Write a program in MATLAB to determine the time response for unity feedback control system. 17. Write a program to determine the static error coefficients and steady-state error for an open loop transfer function using test signals. 18. To verify Bode plot for higher order system using MATLAB. 19. To verify Root locus for higher order system using MATLAB. Hands-on/Computer experiments related to the course contents

Course Title:	Electrical Machines- III(Synchronous Machines)		L	T	P	Cr
Course Code:	ELE340		3	1	0	4
Course Outcome: After completion of course, the students should be able to	CO1	Concept of rotating Magnetic field				
	CO2	Understanding in-depth analysis of alternator				
	CO3	Two reaction theory for salient pole alternator				
	CO4	Synchronous motors various torque such that locked-rotor, running, pull-in and pull-out torque.				
	CO5	Expression of torque/ effect of Excitation				

Unit A	**Synchronous Generators-I (Alternator):** Advantage of rotating field, Relation between speed and frequency, stator and rotor construction Excitation system for synchronous machine, EMF Equation of an alternator, Armature winding, Coil span factor and pitch factor, Distribution factor or breadth factor.	14 Hours
Unit B	**Synchronous Generators-II (Alternator):** Armature reaction in synchronous machine, concept of synchronous impedance, Equivalent circuit and Phasor diagram of a synchronous Generator, Voltage Regulation, and its determination by indirect methods such as Synchronous impedance method, Ampere-turn Method, and Zero Power factor method.Power flow transfer equations for a synchronous Generator, Expression for Complex power output and input of the generator per phase, per phase maximum input and output power for alternator.	14 Hours
Unit C	**Synchronous Generators-III (Alternator):** Two reaction theory, Torque angle characteristics of a salient pole synchronous machine Maximum reactive power for a synchronous generator. Synchronous Generator capability curve, prime-movers characteristics, Expressions for Powers shared by two alternators, Parallel operation of alternators its need, condition and synchronizing process.	13 Hours
Unit D	**Synchronous Motor:** Principle of operation, Equivalent circuit and phasor diagram of a cylindrical rotor synchronous motor, concept of various torque such that locked-rotor, running, pull-in and pull-out torque.Power flow equation, Phasor diagram of salient pole synchronous motor. Expression for developed power by a synchronous motor, Effect of varying field current. Torque developed in cylindrical rotor/salient rotor, V curve and Hunting.	14 Hours
Suggested Books:		

1. Kothari D.P. &Nagrath I.J., "*Electric Machines*", Tata McGrawHill
2. Ghosh Smarajit, "*Electric Machines*", Pearson
3. Fitzerald, A.E., Kingsley and S.D. Umans, "*Electric Machinery*", McGraw Hill.
2. 4.PrithwirajPurkait&IndrayudhBandyopadhyay. "*electricalMachines*",Oxford University Press,2017ed.
5. BimbhraP.S., "*Electrical Machinery*", Khanna Publisher

Course Title:	Electrical Safety and Standards	L	T	P	Cr
Course Code:	ELE343	3	0	0	3

Course Outcome: After completion of course, the students should be able to		
	CO1	Describe electrical hazards and safety equipment.
	CO2	Analyze and apply various grounding and bonding techniques.
	CO3	Select appropriate safety method for low, medium and high voltage equipment.
	CO4	Participate in a safety team
	CO5	Carry out proper maintenance of electrical equipment by understanding various standards

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L2	L3, L4	L3	L3	L3

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	-	2	-	3	3	-	-	2	2	3	3	2	2
CO2	2	3	3	3	3	3	1	-	2	-	-	2	3	2
CO3	3	2	3	2	3	3	-	2	2	-	2	3	2	3
CO4	3	-	2	-	-	2	-	2	3	3	2	-	2	2
CO5	3	3	3	3	3	2	-	2	3	3	2	3	3	2

Unit A

Introduction: Introduction to the concept of safety, safety provisions in the factory act laws related to the industrial safety, measurement of safety performance, safety audit, work permit system, injury and accidents, definitions, unsafe act, unsafe condition, causes, investigations and prevention of accidents, hazards, type of industrial hazards, nature, causes and control measures, hazard identifications and control techniques, HAZOP, FMEA, FMECA etc.

Summarization of International and National standards related to this course.

13 Hours

Unit B	**Concept of Industrial hygiene, programmed:** Recognition, Evaluation, Control, noise source, effects and noise control, exposure limits standards, hearing conservation programmed, Fire, fire load, control and industrial fire protection systems, fire hydrant and extinguishers, electrical hazards, protection and interlock, discharge rod and earthling device, safety in the use of portable tools.
	12 Hours
Unit C	**Logics of consequence analysis:** Estimation-Toxic release and toxic effects, threshold limit values, emergency planning and preparedness, air pollution classification, dispersion modelling, pollution source and effects, control method and equipment's gravitational settling chambers, cyclone separators, fabric filter systems, scrubbers.
	12 Hours
Unit D	**Concept of reliability:** Definition-Failure rate and hazard function, system reliability models series, parallel systems, reliability hazard function for distribution functions, exponential normal, lognormal, Weibull and gamma distribution.
	12 Hours

Suggested Books:

1Crowl, Daniel A., and Joseph F. Louvar. *Chemical process safety: fundamentals with applications*. Pearson Education, 2001.

2 Cameron, Ian T., and Raghu Raman. *Process systems risk management*. Elsevier, 2005.

3. Gupta, Amit. *Industrial safety and environment*. Firewall Media, 2006.

4. Daugherty, Jack E. *Industrial safety management: a practical approach*. Government Institutes, 1998.

5. Deshmukh, L. M. *Industrial Safety Management: Hazard Identification and Risk Control*. McGraw-Hill Education, 2005.

Course Title:	Power System Laboratory		L	T	P	Cr
Course Code:	ELE309		0	0	2	1
Course Outcome: After completion of course, the students should be able to	CO1	Carryout experiments ensuring the safety of equipment and personnel				
	CO2	Interpret the experimental results and correlating them with the practical power system.				
	CO3	analyze the performance of a transmission line				
	CO4	Analyze the power system data for load-flow and fault studies				
	CO5	Apply computational methods for large scale power system studies				

To understand the practicability of **Power System Laboratory**, the list of experiments to be performed in the laboratory is given below

List of Experiments:

1. To measure the dielectric strength of transformer oil.
2. To find string efficiency of string insulator.
   i. Without guard ring
   ii. With guard ring
3. To analyze the performance of a transmission line. Also compute its ABCD parameters, hybrid parameter and image parameter of given transmission model.
4. To plot power angle characteristics of transmission line.
5. Parallel operation of two alternators.
6. To create unbalanced voltage system and to measure the sequence voltage by segregating network.
7. To study the characteristics of transmission line represented by
   ii. T- network
   iii. Pie-network.
8. To analyse the characteristics of differential relay.
9. To plot the characteristics of an IDMT static relay.
10. Testing of current transformer.
11. To find zero sequence component of three-phase line.
12. To draw the characteristics of thermal overload relay.
13. To analyze the characteristics of overcurrent and earth fault protection.
14. To perform the experiment for the operating characteristics of fuse. (HRC or open type)
15. To find the earth resistance and electrode resistance using three spikes/Megger earth tester test electrodes.
16. To study the different types of faults on transmission line/on three phase transformer demonstration panel/model.
17. To analyze the radial feeder performance when (a) Fed at one end. (b) Fed at both ends (c) Fed at center (d) Ring main distribution system
18. To perform the experiment for the performance of under voltage relay
19. To perform the experiment for the working of overvoltage relay.
20. To perform the experiment for the characteristics of bimetal mini circuit breakers.
21. To perform the experiment for the characteristics of Distance Relay.
22. To perform short circuit analysis – symmetrical faults.
23. To perform short circuit analysis – unsymmetrical faults.
24. To perform transient stability analysis.
25. To perform harmonic analysis.

Course Title:	ASYNCHRONOUS &SYNCHRONOUS MACHINES Laboratory		L	T	P	Cr
Course Code:	ELE341		0	0	2	1
Course Outcome: After completion of course, the students should be able to	CO1	**Perform Load/No-Load test on Induction motor**				
	CO2	**Introduction of Kramer drive**				
	CO3	**Study of torque-slip/ Power-slip characteristics of Induction motor.**				
	CO4	**Perform Load/No-Load test on single phase Induction motor**				
	CO5	Parallel operation of three-phase alternators				

To understand the practicability of**ASYNCHRONOUS &SYNCHRONOUS MACHINES Laboratory**, the list of experiments to be performed in the laboratory is given below

List of Experiments:

1. To perform load-test on three-phase Induction motor and to plot torque versus speed characteristics.
2. To perform no-load and blocked–rotor tests on three-phase Induction motor to obtain equivalent circuit.
3. To perform the speed control of three-phase Induction motor by Kramer's Concept.
4. To perform the speed control of three-phase Induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor.
5. To use star- delta starters physically and
   a) To draw electrical connection diagram
   b) To start the three-phase Induction motor using it.
   c) To reverse the direction of three-phase Induction motor
6. To start a three-phase slip–ring induction motor by inserting different levels of resistance in the rotor Circuit and to plot torque-speed characteristics.
7. To perform no-load and blocked–rotor test on single-phase Induction motor and to determine the parameters of equivalent circuit. Drawn on the basis of double revolving field theory.
8. To perform load–test on single-phase. Induction motor and plot torque-speed characteristics.
9. To perform no load and short circuit. Test on three-phase alternator and draw open and short circuit characteristics.
10. To find voltage regulation of an alternator by zero power factor (ZPF) method.
11. To study effect of variation of field current upon the stator current and power factor with synchronous motor running at no load and draw Voltage and inverted Voltage curves of motor.
12. To measure negative sequence and zero sequence reactance of Synchronous Machines.
13. Parallel operation of three-phase alternators using
    • Dark lamp method
    • Two-Bright and one dark lamp method
14. To use synchro scope physically and parallel operation of three-phase alternators using synchro scope.
15. Starting of synchronous motors using
    - Auxiliary motor
    - Using Damper windings

Course Title:	Technical Communication		L	T	P	Cr
Course Code:	ENG351		3	0	0	3
Course Outcome: After completion of course, the students should be able to	CO1	Nature of Technical Communication				
	CO2	Barriers to Communication				
	CO3	Conversation: Formal and Informal				
	CO4	Report Writing				
	CO5	C.V. and Resume&Business Letters formation				
Unit A	Nature of Technical Communication Verbal and Non-Verbal Communication Barriers to Communication					
			14 Hours			
Unit B	Conversation: Formal and Informal Sounds of English (Speech Skills) Panel Discussion and Group Discussion Oral Presentation					
			12 Hours			
Unit C	Report Writing Business and Technical Proposals Memos					
			12 Hours			
Unit D	C.V. and Resume Business Letters and Application Letters Interview					
			12 Hours			

Suggested Books:

1. Koneru, Aruna. Professional Communication. Delhi: McGraw, 2008. Print.
2. Rizvi, M. Ashraf. Effective Technical Communication. Delhi: McGraw, 2005. Print.
3. Sharma, R.C. and Krishna Mohan. Business Correspondence and Report Writing. Delhi: McGraw, 2013. Print.
4. Tyagi, Kavita and Padma Misra. Basic Technical Communication. Delhi: PHI Learning, 2013. Print

Course Title:	Electric Drives	L	T	P	Cr
Course Code:	ELE326	3	1	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	To understand Fundamentals theoretical concepts of electric drives.
	CO2	Analyse the performance of dc motor drives
	CO3	Analyse the performance of induction motor drives for various operating conditions
	CO4	**To understand dynamics of electrical Drive**
	CO5	To acquire the knowledge of drives in industry in special reference with microprocessor controlled drives.

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L2	L4	L4	L4	L2

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	-	-	1	2	-	-	1	3	1	-	2	1	-
CO2	2	2	-	2	-	1	-	-	2	-	-	-	3	2
CO3	2	2	3	3	1	-	1	-	1	1	1	1	2	3
CO4	3	2	1	-	-	1	-	1	2	1	-	2	3	1
CO5	3	-	3	1	1	1	-	-	1	1	-	2	2	1

Unit A

Introduction: Definition & Classification of different type of drives, review of characteristics and components of electric drives, speed control methods of various a.c. and d.c. drives, its advantages and applications, acceleration and retardation time, energy consideration.

Braking of drives: Various methods of braking of a.c. and d.c. drives, automatic control arrangement, characteristics and application, acceleration and retardation time, energy consideration.

14 Hours

Unit B

D.C. drives: Rectifier controlled circuits, single phase fully controlled and half controlled rectifier fed separately excited d.c. motor, 3-phase fully and half controlled fed separately excited d.c. motor, performance and characteristics of single phase and 3-phase rectifier controlled d.c. drives. Control techniques of d.c. drives using chopper, multi-quadrant control of chopper fed motors.

13 Hours

Unit C	**Induction motor (A.C) drives:** Basic principle of induction motor drives, 3-phase a.c. voltage controller fed I.M. drive, variable frequency control, voltage source inverter (VSI) and current source inverter (CSI), Cycloconverter fed IM drive, slip power control, static rotor resistance control, chopper control of 3-phase slip ring induction motor. **Dynamics of electric drives:** Components & classification of load torque, fundamental load torque equation, permissible frequency of starting and stopping, definite time, speed torque conventions. Speed and current limit control, automatic starting and pulling operation of synchronous motors.
	14 Hours
Unit D	**Synchronous Motor Drive: Control** of Synchronous Motors: Separate control & self-control of synchronous motors – Operation of self-controlled synchronous motors by VSI and CSI cycloconverters. Load commutated CSI fed Synchronous Motor – Operation – Waveforms – speed torque characteristics – Applications – Advantages and Numerical Problems – Closed Loop control operation of synchronous motor drives (Block Diagram Only), variable frequency control, Cyclo converter, PWM, VFI, CS
	14 Hours

Suggested Books:

1. Filizadeh, Shaahin. Electric machines and drives: principles, control, modeling, and simulation. CRC Press, 2013.
2. Boldea, Ion, and Syed A. Nasar. *Electric drives*. CRC press, 2016.
3. Subrahmanyam, Vedam. *Thyristor control of electric drives*. Tata McGraw-Hill Education, 1987
4. Siskind, Charles Seymour. *Electrical Control Systems in Industry*. Glencoe/McGraw-Hill School Publishing Company, 1963.
5. Dubey, Gopal K. *Fundamentals of electrical drives*. CRC press, 2002..

Course Title:	Microprocessors and Microcontrollers	L	T	P	Cr
Course Code:	ELE410	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	study about history, architecture of Microprocessor. 8085 and microcontroller 8051.
	CO2	develop knowledge of programming of 8051 microcontroller using assembly language.
	CO3	analyze 8051 microcontroller design, memory mapping and serial data transmission.
	CO4	be conversant in application of 8051 microcontroller.
	CO5	be aware in the application of PLC and its programming.

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1	L1,L2,L3	L4	L4,L5	L5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO 1	3	-	-	-	3	2	-	-	-	1	-	2	3	1
CO 2	3	3	3	2	2	1	-	-	2	2	2	2	3	1
CO 3	3	3	2	3	2	2	-	-	-	2	3	2	3	1
CO 4	3	2	3	2	3	1	1	-	-	2	-	2	3	1
CO 5	3	2	3	2	3	3	1	-	2	3	2	3	3	1

Unit A

Introduction: Microprocessor, Fundamentals of Microprocessor Architecture. 8-bit microprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Micro-controllers and their comparison. The 8051 Architecture: Introduction, 8051 micro-controller hardware, input/ output, pins, ports and circuits, external memory, counters and timers, serial data input/ output, interrupts

8051 Assembly Language Programming: The mechanics of programming, assembly language programming process, programming tools and techniques, instruction set (data moving, logical operations, arithmetic operations, jump and call instructions)

14 Hours

Unit B	**8051 Microcontroller Design:** Micro-controller specification, external memory and memory space decoding, reset and clock circuits, expanding input and output (I/O), memory mapped I/O, memory address decoding, memory access times, testing the design, timing subroutines, Look up tables for the 8051, serial data transmission.
	14Hours
Unit C	**Microcontroller Applications:** RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee. Interfacing keyboards, displays, Digital-to-Analog (D/A) and Analog-to-Digital (A/D), multiple interrupts, serial data communications, introduction to the use of assemblers and simulators Embedded Systems:Stepper motor interfacing, DC Motor interfacing, sensor interfacing,technology and design issues, implementation of 8051 core
	13 Hours
Unit D	**Programmable Logic Controllers (PLC):** Introduction, operation of PLC, difference between PLC and Hardwired system, difference between PLC and Computer, relay logic and ladder logic, ladder commands and examples of PLC ladder diagram realization, PLC timers, PLC counters, PLC classification. Projects related to this course should be given to students(in groups) in order to promote team work and ethical values.
	14 Hours

Suggested Books:

Kenneth J Ayala,"*The 8051 Micro Controller- Architecture, Programming and Application*", Penram International Publication
2. John B Peatman,, "*Design with Micro Controller*", Tata McGraw Hill
3. Ray A. K. and Bhurchandi K. M., "*Advanced Microprocessors and Peripherals; Architecture,Programming and Interfacing*", Tata McGraw Hill
4. Mazidi M. A. and Mazidi J. G., "*The 8051 Micro-controller and Embedded System*", Pearson Education.
5. Udayashankara V. and Mallikarjunaswamy M.S., "*8051 Microcontroller Hardware, Software and Applications*", TataMcGraw Hill Education Pvt. Ltd., 2010.

1.

Course Title:	Microprocessors, Microcontroller and PLC Laboratory		L	T	P	Cr
Course Code:	ELE411		0	0	2	1
Course Outcome: After completion of course, the students should be able to	CO1	create programmes for various mathematical operations like addition, subtraction of numbers in decimal, hexadecimal and BCD system.				
	CO2	develop the understanding of various microprocessor and microcontroller kits.				
	CO3	gain practical understanding of the programmable logic console				
	CO4	implement ladder logic programming for small applications.				
	CO5	develop programming codes for laboratory projects				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1,L2	L2	L3	L4	L5,L6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	2	-	1	2	2	-	2	2	1
CO2	2	2	2	1	2	2	1	-	1	2	2	2	1	1
CO3	3	-	2	3	2	2	-	-	1	2	2	2	1	1
CO4	3	2	2	3	-	2	1	1	2	2	2	2	2	1
CO5	3	2	3	3	2	2	1	1	2	2	2	3	2	1

To understand the practicability of **Microprocessors, Microcontroller and PLC Laboratory**, the list of experiments to be performed in the laboratory is given below

List of Experiments:	1. Study of 8085/ 8086 microprocessor kits. 2. Study of 8051/8031 Micro-controller kits. 3. Write a program to add two 8 bit numbers lying at two memory locations and display the result using 8051 MC. 4. Write a program to subtract two 8-bit numbers lying at two memory locations and display the result using 8051 MC. 5. Write a program for multiplication of two 8-bit numbers lying at memory location and display the result using 8051 MC. 6. Write a program for division of two 8-bit numbers lying at memory location and display the result using 8051 MC. 7. Write a program to perform multibyte addition of numbers lying at two memory locations and display the result using 8051 MC 8. Write a program to display largest number in an array and show the result on display 9. Write a program to arrange TEN numbers stored in memory location in ascending and descending order. 10. Write a program to convert BCD to Hexadecimal of a given number. 11. Write a program to convert Hexadecimal to BCD of a given number 12. Write a program to calculate the square root of a number. 13. Implementation of DOL and star delta starter using PLC. 14. Implementation of star delta starter using timer in PLC 15. Make a PLC-based control system for conveyor belt.

Course Title:	Project Laboratory		L	T	P	Cr
Course Code:	ELE451A		0	0	8	4
Course Outcome: After completion of course, the students should be able to	CO1	communicate their work effectively through writing and presentation.				
	CO2	use research based knowledge in the latest area of technology.				
	CO3	engage in independent and life-long learning.				
	CO4	implement the project requiring individual and teamwork skills.				
	CO5	carry out design calculations and implementations in the area of project.				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L2	L1,L2	L3	L4	L6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	2	2	-	-	3	3	-	3	3	1
CO2	3	2	3	3	3	3	-	-	2	3	1	3	3	1
CO3	3	3	2	3	2	2	-	-	-	3	-	3	3	3
CO4	3	1	1	-	-	1	-	-	1	3	1	3	1	3
CO5	3	2	3	3	2	3	-	-	2	-	1	3	3	1

The objective of Project Work is to enable the student to take up investigative study in the broad field of Electrical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment normally includes:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary approach to the Problem relating to the assigned topic;
3. Conducting preliminary analysis/Modelling/Simulation/Experiment/Design/Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the Department.
5. Final Seminar, as oral Presentation before a Departmental Committee including external expert

Course Title:	Industrial Training-II	L	T	P	Cr
Course Code:	ELE406A	0	0	0	2

Course Outcome: After completion of course, the students should be able to		
	CO1	implement the project requiring individual and teamwork skills
	CO2	correlate the theoretical concepts with the real life industrial environment.
	CO3	gather and analyze the scientific information
	CO4	communicate their work effectively through writing and presentation

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4
RBTL No.	L3	L4	L4	L5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	-	2	2	-	-	3	3	3	-	3	3	1
CO2	3	2	3	3	3	3	2	2	2	3	1	3	3	1
CO3	3	3	2	3	-	2	2	-	1	3	-	3	3	3
CO4	1	-	1	1	1	-	-	-	1	3	1	3	1	3

Objective of the training programme is to

1. Enrich the students with a basic understanding of the Electrical Engineering, towards developing a holistic perspective to understand various practical issues and latest trends in the field.
2. Familiarize and provide “hands-on” training experience with the requisite simulation, design, and analytical tools and techniques.
3. Achieve a long-term goal of transforming themselves into a brilliant blend of theoretician and practicing engineer.
4. Introduce the way of troubleshooting various engineering faults related to respective fields.
5. Make the students able to present work in written, oral or formal presentation formats.

Note: The end of the examination of 6th Semester the students will undergo compulsory summer training for a period of 6 weeks. Every student will submit the Summer Training Report within two weeks from the start of teaching for 7th Semester.

Course Title:	Utilization & Traction	L	T	P	Cr
Course Code:	ELE412	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	acquire the knowledge of different type of electrical heating and welding methods
	CO2	know about various electrical rating of motors
	CO3	fulfill the objective of utilization application of electrical energy in electrochemical process
	CO4	know about various electrical circuits used in refrigeration and air conditioning.
	CO5	analyze the various methods of illumination and electric traction system.

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1	L2, L3	L3	L1	L4

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	-	2	-	2	1	1	-	3	2	2	-	3	2
CO2	3	2	2	2	2	2	1	-	3	-	2	2	3	3
CO3	3	3	3	2	-	2	-	-	3	-	-	1	3	3
CO4	2	2	3	2	2	2	-	-	3	2	2	2	3	3
CO5	3	3	3	3	3	3	1	-	3	2	2	-	3	3

Unit A

Illumination: Term used in illumination, Law's of illumination, sources of Light, arc lamp incandescent lamp, discharge lamp, sodium vapor, mercury vapor lamp, Fluorescent tubes, lightening schemes, method of lightning calculation.

14 Hours

Unit B

Electrical Heating: Advantages of Electrical Heating, various types of Electrical heating, Power frequency and High-frequency heating, Degree of heating element, Equivalent circuit of arc furnace, Resistance heating, Arc heating, Induction heating, dielectric heating etc.

Electric Welding: All types of electrical welding, resistance welding, arc welding, electrical winding equipment, Comparison between AC & DC welding, types of electrodes, advantages of coated electrodes.

13 Hours

Unit C	**Electroplating:** Basic principle, Faraday's law of electrostatics, terms used, Application of electrolysis, factors governing electrodeposition, power supply. **Refrigeration & Air Conditioning:** Basic principle, various compression cycle & system its application, electric circuit of refrigerator, air conditioner.
	14 Hours
Unit D	**Traction Motors:** Different system of electric traction, comparison between AC & DC system, block diagram of traction system, Starting-Speed control and braking- Speed control and braking –Speed time curves, -Mechanics of Train Movement-Tractive effort for acceleration – Power and energy output from driving Axles-Specific energy output and Consumption-Train resistance. **Rating of motors:** Determination of motor rating, nature of loads and classes of motor duty, frequency of operation of motor subjected to intermittent loads, pulse loads etc. thermal model of motor for heating and cooling.
	14 Hours

Suggested Books:

1. Uppal S.L., "*Electrical Power"* Khanna Publishers, New Delhi,1980.
2. Soni M.L., Gupta P.V., Bhatnagar U.S., Chakrabarti ,A*"A Text Book On Power System Engineering*", DhanpatRai& Co, 1998.
3. Pratap H, "*Art and Science of Utilization of Electric Energy"*, DhanpatRai&Sons,New Delhi,1980.
4. Gupta J.B, "*Utilization of electric power and Electric Traction",*S.K.Kataria& Sons.
5. Garg, G.C. "Utilization of Electric Power and Electric Traction", Khanna publishers, New Delhi,1995.

Course Title:	High Voltage Engineering	L	T	P	Cr
Course Code:	ELE477	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	develop the concept of high voltage transmission.
	CO2	acquire the knowledge of conducting and insulating materials requirements in voltage transmission system.
	CO3	Gain the knowledge of the various reasons of overvoltage in power system and protection methods against them.
	CO4	Understand the insulation coordination and design of insulation levels of various parts of power system.
	CO5	gain the knowledge of high voltage generation.

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1,L2	L2	L2	L4	L2

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	1	2	-	-	-	1	3	-	3	2	1
CO2	3	1	1	3	2	1	-	-	1	2	-	2	2	2
CO3	3	2	-	2	2	2	1	-	2	2	1	2	3	2
CO4	3	1	1	-	2	2	1	-	2	2	-	2	2	2
CO5	3	3	2	1	1	2	-	1	1	2	1	2	3	2

Unit A	
	E.H.V. Transmission and Corona Loss; Need for EHV transmission. Use of bundled conductors, corona characteristics of smooth bundled conductors with different configurations, corona loss. Factors affecting the corona loss, radio interference due to corona. Shunt and series compensation in EHV lines. Tuned power lines. Insulation co-ordination. **HVDC Transmission:** Advantages, disadvantages and economics of HVDC Transmission system. Types of D.C. links, converter station equipment, their characteristics
	14 Hours

Unit B	**Lightning and Switching Over-voltages:** Charge formation in clouds, stepped leader, dart leader, lightning surges. Switching over voltages, protection against over-voltages, surge diverters, surge modifiers. **Conduction and breakdown in Gases, Liquids & Solid Dielectrics**: Solids - Intrinsic, electromechanical and thermal breakdown composite dielectrics, solid dielectrics used in practice. Liquids: - Conduction and breakdown in pure and commercial liquids, suspended particle theory, cavitation and bubble theory, stressed oil volume theory, liquids used in practice. Gases: - Ionization process, Townsend's current growth equations, 1st and 2nd ionization coefficients. Townsend's criterion for breakdown. Streamer theory of breakdown, Pashen's law of Gases, Gases used in practice.
	13 Hours
Unit C	**Generation of High Voltages:** D.C., A.C. (Power frequency and High frequency) impulse voltage and impulse current generation tripping and contact of impulse generator **Test procedures in H.V. Engineering Lab**.: Testing of cables, insulators, bushings, circuit breakers and transformers.
	14 Hours
Unit D	**Measurements of High Voltages and Currents**: Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements. Projects related to this course should be given to students(in groups) in order to promote team work and ethical values.
	14 Hours

Suggested Books:

1. Bagamudre, Das Rakesh, "*Extra High Voltage A.C. Transmission Engineering"*, New Age International Publishers.
2. Kimbark E.W., "*High Voltage Direct Current Transmission"*, Wiley-Interscience
3. Kamaraju V. and Naidu M.S., "*High Voltage Engineering",* Tata McGraw-Hill Education

Course Title:	Seminar		L	T	P	Cr
Course Code:	ELE452		0	0	4	2
Course Outcome: After completion of course, the students should be able to	CO1	communicate their work effectively through writing and presentation.				
	CO2	use research-based knowledge for presentation				
	CO3	engage in effective communication to display the technical knowledge efficiently and life-long learning.				
	CO4	implement the confidence to represent latest knowledge				
	CO5	carry out awareness and regular facts of the technical advancements				

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L2, L3	L3	L3	L3	L6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	-	-	-	2	2	-	-	3	3	-	3	3	1
CO2	3	2	3	3	3	3	-	-	2	3	1	3	3	1
CO3	3	3	2	3	2	2	-	-	-	3	-	3	3	3
CO4	3	1	1	-	-	1	-	-	1	3	1	3	1	3
CO5	3	2	3	3	2	3	-	-	2	-	1	3	3	1

Individual students are required to choose a topic of their interest from energy-related engineering topics preferably from outside the B.Tech syllabus and give a seminar on that topic about 30 minutes followed by a 10 minutes session for discussion/question and answers. A committee consisting of at least three faculty members (preferably specialized in Electrical Engineering) shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Note:

i. The seminar topic selected by the student must be approved by the authorized faculty of the department at least two weeks in advance.
ii. Each student has to submit to the department a seminar report at least three days before the day of seminar.
iii. Each student has to make the PowerPoint presentation with multi-media projector.

Course Title:	ELECTRICAL MACHINE DESIGN	L	T	P	Cr
Course Code:	ELE327	3	1	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	analyze design features and limitation of machine design
	CO2	understand design parameters for DC Machines.
	CO3	understand design parameters for Transformers
	CO4	acquire knowledge of design for AC Machines
	CO5	acquire computer aided design of electrical machines

Unit A	**GENERAL:** General features & limitations of electrical machine design, types of enclosures, heat dissipation, temperature rise, heating & cooling cycles, rating of machines, cooling media used & effect of size and ventilation. **DC MACHINES :**Output equation, choice of specific loadings, choice of poles and speed, Design of conductors, windings, slots field poles, field coils, commutator and machine design.
	14 Hours
Unit B	**TRANSFORMERS:** Standard specifications, output equations, design of core, coil, tank and Cooling tubes, calculation of circuit parameters, magnetizing current, losses and efficiency, Temperature rise and regulations from design data. **SYNCHRONOUS MACHINES**: Specifications, ratings and dimensions, specific loadings, main dimensions, low-speed machines, turbo generators, armature conductors, cooling
	14 Hours
Unit C	**INDUCTION MOTORS:** Three Phase Induction Motor: Standard specifications, output equations, specific loadings, main dimensions, conductor size and turns, no. of slots, slot design, stator core, rotor design, performance calculations. **Single Phase Induction Motor**: output equations, specific loadings, main dimensions, design of main and auxiliary winding, capacitor design, equivalent circuit parameters, torque, efficiency.
	13 Hours
Unit D	**Computer Aided Design:** Computerization of design procedures, development of computer programs & performance predictions, optimization techniques & their application to design problems.
	14 Hours
Suggested Books:	

1. M.G.Say, "*Performance and design of ac machines*" , CBS Publishers.
2. S.K. Sen., "*Principles of electrical machine design with computer programs*", Oxford and IBH publishing co. 1987.
3. A.E.Clayton, Hencock, "*Performance and design of dc machines*", CBS Publishers.
4. J.H. Kuhlmann, "*Design of electrical operators*", John Willey, 1957.
5. CG Veinott, "*Theory and design of small induction machines*", MGH, 1959.
6. A Shanmugasundarem, "*Electrical machine design databook*", PHI

Course Title:	ENERGY EFFICIENT MACHINES	L	T	P	Cr
Course Code:	ELE332	3	1	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	analyze need of energy efficient machines
	CO2	understand the standards of energy efficient motors
	CO3	understand the concept of power factor improvement
	CO4	understand the energy conservation and drive system.
	CO5	acquire knowledge of efficiency labelling

Unit A	**Introduction**: Need for energy efficient machines, energy cost and two-part tariff, energy conservation in industries and farms -a necessity, introduction to energy management and energy audit system. Review of induction motor characteristics.	14 Hours
Unit B	**Energy efficient motors:** Standard motor efficiency, why more efficient motors? An energy efficient motor, efficiency determination methods, Direct Measurement method, Loss segregation method, Comparison, motor efficiency labeling, energy efficient motor standards. Motor life cycle	14 Hours
Unit C	**Power factor:** The power factor in sinusoidal systems, power factor improvement, power factor with nonlinear loads, Harmonics and the power factor	13 Hours
Unit D	**Induction motors and adjustable drive systems**: Energy Conservation, adjustable speed systems, Application of adjustable speed systems to fans, pumps and constant torque loads.	14 Hours

Suggested Books:

1. Andreas John, C. "Energy-efficient electric motors." (1992).
2. Thuman Albert, "*Introduction to Efficient Electric System Design"*, The Fairmount Press Prentice Hall.
3. Tripathy, S. C. "Electric energy utilization and conservation." (1991).
4. Belove, Charles. *Handbook of modern electronics and electrical engineering*. Ed. Phillip Hopkins. New York: Wiley, 1986.

Course Title:	BIOMEDICAL ENGINEERING	L	T	P	Cr
Course Code:	ELE333	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	know about basic nervous, circulatory and respiratory system and origin ofbio-potentials
	CO2	utilize the concept of various bioelectric signals and electrodes for EEG, EMG and ECG.
	CO3	know about the various Measurement and Analysis Techniques , X-Rays and computerized tomography and use them in diagnosis of disease.
	CO4	exercise knowledge of Physical Medicine and Assist Devices and radio therapy,
	CO5	learn physiological parameters and components of telemedicine, biotelemetry system and their applications in medical field.

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L2, L3	L3	L3	L3	L6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	-	-	-	2	2	-	-	3	3	-	3	-	1
CO2	3	2	3	3	3	3	-	-	2	3	1	3	-	1
CO3	3	3	2	3	2	2	-	-	-	3	-	3	-	3
CO4	3	1	1	-	-	1	-	-	1	3	1	3	1	3
CO5	3	2	3	3	2	3	-	-	2	-	1	3	-	1

Unit A

Physiological Transducers: Introduction to physiological systems, Pressure transducers, Transducer for body temperature measurement. Pulse sensors, Respiration sensors.

Bio-Electric Signals and Electrodes: Origin of bio-electric signals, Recording electrodes, Polarization Skin contact impendence, Electrodes for ECG, EEG, Electrical conductivity of electrode jellies and creams, Microelectrodes.

14 Hours

Unit B

Measurement and Analysis Techniques: Blood flow meters, Cardiac Output measurement, Pulmonary function analyzers, Spiro-meter, Respiratory gas analyzers, Blood gas analyzers Blood pH, PCO2, PO2 measurement, Blood cell counters, Audiometer, Pure tone audio meters, Speech audiometers Evoked response audio-metric systems, Oxy-meters.

X-Ray and Ultrasonic Diagnosis: Soft & Hard X-Rays. X-Ray generators for diagnosis. Radiography, Angiography, Fluoroscopy, X-Ray computed tomography, Ultrasonic principles, Application of ultrasonic for diagnosis.

14 Hours

Unit C	**Physical Medicine and Assist Devices:** Diathermy-Short wave, ultrasonic and Microwave, Range and area of irritation of each type, Nerve and muscle simulators, Pacemakers external and implantable pacemakers, DC defibrillators, Defibrillator with synchronizer, Implantable Defibrillators. **Radiotherapy:** X-Ray therapy, Radionuclide therapy, Units for radiation and radiation dose.
	13 Hours
Unit D	**Bio-Telemetry:** Physiological parameters adaptable to bio-telemetry, Components of a biotelemetry system, Implantable units, Application of telemetry in patient care. **Introduction to Telemedicine:** Telemedicine System's classification, input and output peripherals, Characteristic of available transmission media, introduction to communication system for telemedicine. Medical image format standards, introduction to DICOM and PACs technologies various image compression techniques, lossless and lossy image compression for biomedical application. Telemedicine and law, confidentiality of telemedicine records, security in medical methods.
	14 Hours

Suggested Books:

1. Khandpur R. S, "*Handbook of Biomedical Instrumentation"*, TMH Publication
2. Pratt Cromwell, "*Biomedical Instrumentation",* Prentice Hall
3. Webster John G , "*Medical Instrumentation",* Applications &Design, John Wiley
4. Geddes, Baker "*Principles of Applied Biomedical Instrumentation"*, John Wiley

Course Title:	INDUSTRIAL PROCESS CONTROL	L	T	P	Cr
Course Code:	ELE334	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	analyze and formulate mathematical model of process element.
	CO2	understand the concept of process control
	CO3	demonstrate the working of various control valves and their selection criteria
	CO4	understand the operation SPC and DDC controllers
	CO5	acquire knowledge of various intelligent controllers

Unit A	**Description And Modeling Of Various Industrial Processes:** Model Classification, Mathematical Models, Physical Models, Analog Models, Estimation of Model Parameters, System Identification, Experimental Nature of Simulation, Steps Involved in Simulation Studies, Validation of Simulation Models, Computer Simulation of Continuous and Discrete Systems	**14 Hours**
Unit B	**Process Control:** Types and Description of Processes, Blending, batch processes, compressor & chiller controls, distillation control, steam turbine & water treatment controls, boiler controls, reactor controls	**14 Hours**
Unit C	**Conventional Controllers:** On-off Controllers, Cascade and Feed forward Controllers, Split Range Controllers, ratio controls, Single loop, multi loop &self tuning controllers, set point control (SPC), discrete digital control (DDC)	**13 Hours**
Unit D	**Intelligent Controllers:** Fuzzy logic control, programmable logic controllers, PC based system, conventional and windows NT based DCS systems, artificial intelligence & neural networks, smart & intelligent transmitters.	**14 Hours**

Suggested Books:

1. Padmanabhan, "*Industrial Process Instrumentation and control"*, Springer Publishing
2. Andrew W.G. & Williams H.B., "*Applied Instrumentation in the Process Industries"*, Gulf Publishing, Houston
3. Nolting B.E., "*Instrumentation Reference Book"*, Elsevier India Pvt ,New Delhi
4. Liptak B.G., "*Instrument Engineer's Handbook (Process Control")*, Elsevier India Pvt ,New Delhi

Course Title:	COMMUNICATION SYSTEMS	L	T	P	Cr
Course Code:	ELE335	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	Gain knowledge about the fundamental concepts of various analog communication systems.
	CO2	Concept of AM, FM and PM transmission and reception.
	CO3	Analyze the data encoding
	CO4	acquire knowledge Asynchronous and Synchronous transmission
	CO5	acquire knowledge of data link control

Unit A	**Concepts & Terminology:** Data communication : data representation, Analog versus digital signals; Direction of Data flow Analog and digital data transmission, data rate limits, Transmission impairments random &nonrandom, Transmission Media- Guided and unguided media, Line configuration, Topology, Categories of networks, Network Architecture – layered protocol TCP/IP and OSI model.
	14 Hours
Unit B	**Data Encoding and Modulation:** Encoding of digital Data: Line coding schemes, Block coding, Encoding Analog data into digital signal: Pulse code modulation, sampling rate, Modulation of Digital data: ASK, FSK, PSK, QAM, Bit/baud comparison Modulation of Analog data: AM, FM and PM
	12 Hours
Unit C	**Transmission of digital data:** Asynchronous and Synchronous transmission, DTE-DCE interface, Multiplexing Techniques – FDM: Multiplexing and de-multiplexing process, Applications of FDM, Analog hierarchy, TDM: Time slots and frames, Synchronizing and Bit padding, Statistical TDM, Digital signal service, T lines.
	15 Hours
Unit D	**Data link Control**: Factor Contributing Errors, , Error Control: Stop & wait ARQ, Go back N & Selective ARQ., Error Detection Methods – parity checking, checksum error detection & CRC, Forward Error Correction Method – block parity, Hamming code, Burst Error Correction Method, Flow control : Stop and wait flow control, Sliding window flow control, Data Link protocols – HDLC, CSMA/CD, token bus, token ring & FDDI.
	14 Hours
Suggested Books:	

Behrouz A Forouzan, "*Data Communications Networking"*, PHI Publishers
2.William Stalling, "*Data and Computer Communication"*, Pearson Education Publishers.
3. Prakash C-Gupta, "*Data Communication"*, PHI Publishers.
4. A. S. Tanenbaum, "*Computer Networks"*, PHI Publishers.

Course Title:	RELIABILITY ENGINEERING	L	T	P	Cr
Course Code:	ELE431	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	gain the knowledge of reliability
	CO2	understand the application of maintenance strategies in manufacturing environment.
	CO3	Will be able to establish maintenance strategies according to system characteristics.
	CO4	develop ability in formulating suitable maintenance strategies to enhance system reliability
	CO5	analyse statistical methods leading to reliability modelling.

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L2	L3	L2, L3	L4

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	2	-	1	1	3	2	3	1	1
CO2	3	2	-	1	2	1	2	1	-	3	2	3	1	1
CO3	3	3	2	-	2	3	1	2	1	3	3	3	3	3
CO4	3	3	2	2	2	3	1	1	2	3	2	3	3	3
CO5	3	3	2	2	2	3	2	-	2	3	1	3	3	3

Unit A

Reliability Fundamentals: Introduction, Importance of reliability, Reliability functions, Failure and Failure Modes, causes of failure, Instantaneous failure rate, General reliability Function

Component Reliability and Hazard Model: Component reliability from Test data, failure data (Failure density, failure rate, reliability, probability of failure) mean failure rate MTTF,MTBF. Hazard Models (Time-dependent Hazard models, Constant Hazard model, Linear Hazard model, non-linear hazard model

14 Hours

Unit B	**System Reliability:** Reliability evaluation of non-maintained systems, series, parallel, series-parallel, non-series, standby configuration, k out of n configuration, complex system, Markov's Method, Fault tree technique, Event space, path Tracing methods, cut-set and tie set method
	13 Hours
Unit C	**Reliability Improvement:** Introduction, Improvement of components, redundancy: standby with perfect and imperfect switching. Comparison of component redundancy to system/unit redundancy, mixed redundancy, standby redundancy **Reliability Allocation:** Introduction, Redundancy allocation and techniques for reliability allocation
	14 Hours
Unit D	**Availability and Maintainability:** Concepts of reliability ,availability and maintainability, types of availability, objectives of maintenance, classification and factor affecting maintenance, maintenance levels, Inventory control of spare parts, Preventive maintenance of some electrical appliances. Projects related to this course should be given to students(in groups) in order to promote team work and ethical values.
	15 Hours

Suggested Books:

1. Srinath, L. S. *Reliability engineering*. New Delhi, Delhi: Affiliated East-West Press, 1991.
2. Balagurusamy, E. *Reliability engineering*. Tata McGraw-Hill Education, 1984.
3. Billinton, Roy, and Ronald Norman Allan. *Reliability evaluation of engineering systems*. New York: Plenum press, 1992.
4. Aggarwal, K. K. *Reliability engineering*. Vol. 3. Springer Science & Business Media, 2012.

Course Title:	Industrial Robotics		L	T	P	Cr
Course Code:			4	0	0	4
Course Outcome: After completion of course, the students should be able to	CO1	learn the fundamentals of Robotics, various actuators and transmission systems.				
	CO2	select an appropriate robot type for a specific manufacturing application.				
	CO3	become conversant in various end effectors, gripping mechanism and Kinematics in robots.				
	CO4	develop programming principles and languages for a robot control system				
	CO5	Study various applications of industrial robot systems				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L2	L3	L4	L4

CO/PO Mapping: (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	1	-	2	2	2	-	3	2	1	2	3	2
CO2	3	1	2	2	3	2	1	-	3	2	2	2	3	3
CO3	3	3	3	2	2	2	1	-	3	3	-	2	3	3
CO4	2	3	3	2	2	2	-	-	3	2	2	2	3	3
CO5	3	1	2	2	3	3	1	1	3	2	1	3	3	3

Unit A

INTRODUCTION: Types of industrial robots, Load handling capacity, general considerations in Robotic material handling, material transfer, machine loading and unloading, CNC machine tool loading, Robot cantered cell.

SELECTION OF ROBOT: Factors influencing the choice of a robot, robot performance testing, economics of robotisation, Impact of robot on industry and society.

		12 Hours
Unit B	**APPLICATIONS:** Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, robot for underwater applications. **END EFFECTORS:** Gripper force analysis and gripper design for typical applications, design of multiple degrees of freedom, active and passive grippers.	
		15 Hours
Unit C	Introduction to Automation Plant design softwares. **ROBOTS FOR INSPECTION:** Robotic vision systems, image representation, object recognition and categorization, depth measurement, image data compression, visual inspection, software considerations.	
		14 Hours
Unit D	**MATERIAL HANDLING:** concepts of material handling, principles and considerations in material handling systems design, conventional material handling systems - industrial trucks, monorails, rail guided vehicles, conveyor systems, cranes and hoists, advanced material handling systems, automated guided vehicle systems, automated storage and retrieval systems(ASRS), bar code technology, radio frequency identification technology. Projects related to this course should be given to students(in groups) in order to promote team work and ethical values.	
		14 Hours

Suggested Books:

1. Klafter, Richard D., Thomas A. Chmielewski, and Michael Negin. Robotic engineering: an integrated approach. 1989.
2. Groover, Mikell P. Automation, production systems, and computer-integrated manufacturing. Pearson Education India, 2016.
3. Rehg, James A. Introduction to robotics in CIM systems. New Jersey: Prentice Hall, 1997.

Course Title:	DIGITAL CONTROL SYSTEMS		L	T	P	Cr
Course Code:	ELE447		3	1	0	4
Course Outcome: After completion of course, the students should be able to	CO1	understand the basic principles and modeling of digital control system in transfer function and state-space domain.				
	CO2	analyse application of Laplace and Z-transforms and its correlation for digital control system.				
	CO3	apply different aspect of time response like steady state analysis, transient response analysis with system pole location, disturbance rejection, robustness and sensitivity analysis				
	CO4	Solve various stability criteria, and Bilinear transformation for various systems.				
	CO5	learn the design procedure for controller for digital control system using root locus method, Bilinear transformation				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1,L2	L3	L3	L4	L5,L6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	1	-	-	-	-	-	1	1	1	2	1	1
CO2	3	2	2	1	2	-	-	1	1	2	1	3	1	1
CO3	2	2	3	1	2	-	-	-	-	3	1	2	2	1
CO4	3	3	3	2	2	1	-	-	2	-	2	3	1	1
CO5	3	2	3	-	2	-	1	-	-	1	2	2	2	1

Unit A	**Discrete Representation of Continuous Systems** Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent. **Discrete System Analysis** Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed-loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.
	14 Hours
Unit B	**Stability of Discrete-Time System (4 hours)** Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with deadbeat response. Practical issues with deadbeat response design
	13 Hours
Unit C	**State Space Approach for discrete time systems** State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole-zero cancellation on the controllability & observability.
	14 Hours
Unit D	**Design of Digital Control System** Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator. **Discrete output feedback control** Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete-time systems. Projects related to this course should be given to students(in groups) in order to promote team work and ethical values.
	14 Hours

Suggested Books:

1. K. Ogata, "*Digital Control Engineering*", Prentice Hall, Englewood Cliffs, 1995.
2. M. Gopal, "*Digital Control Engineering*", Wiley Eastern, 1988.
3. G. F. Franklin, J. D. Powell and M. L. Workman, "*Digital Control of Dynamic Systems*", Addison-Wesley, 1998.
4. B.C. Kuo, "*Digital Control System*", Holt, Rinehart and Winston, 1980.

Course Title:	MICROSENSORS AND SMART DEVICES		L	T	P	Cr
Course Code:	ELE439		4	0	0	4
Course Outcome: After completion of course, the students should be able to	CO1	Be familiar with the important concepts applicable to MEMS, their fabrication.				
	CO2	Be fluent with the design, analysis and testing of MEMS.				
	CO3	Apply the knowledge of MEMS for different applications.				
	CO4	Gain the knowledge of sensors for bioinstrumentation				
	CO5	identify various fabrication and machining process of MEMS				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1,L2	L3	L2,L3	L4	L5

CO/PO Mapping:(Strong (3) / Medium (2) / Weak (1) indicates strength of correlation)

COs	COs Program Outcomes (POs)/ Program Specific Outcomes (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	2	2	2	-	3	3	1	3	3	1
CO2	3	-	3	3	3	3	1	2	2	3	-	2	3	1
CO3	3	3	2	3	2	2	2	2	1	3	2	2	3	3
CO4	3	1	1	-	1	2	1	1	1	3	2	3	1	3
CO5	3	3	2	2	1	1	-	1	2	3	1	2	2	2

Unit A	**Overview:** Overview of biosensors and their electrochemistry: Molecular reorganization: enzymes, Antibodies and DNA, Modification of biorecognition molecules for Selectivity and sensitivity Fundamentals of surfaces and interfaces.
	14 Hours

Unit B	**Bioinstrumentation:** Bioinstrumentation and bioelectronics devices: Principles of potentiometry and potentiometric biosensors, principles of amperometry and amperometric biosensors, Optical Biosensors based on Fiber optics, FETs and Bio-MEMS, Introduction to Chemometrics, biosensor arrays; electronic nose and electronic tongue
	13 Hours
Unit C	**MEMS Technology:** MEMS Technology: Introduction Nanotechnology and MEMS, MEMS design, and fabrication technology, Lithography, Etching, MEMS material, bulk micromachining, Surface micromachining, Microactuator, electrostatic actuation Micro-fluidics
	14 Hours
Unit D	**Applications**: MEMS types and their applications: Mechanical MEMS strain and pressure sensors, accelerometers etc., Electromagnetic MEMS, micromotors, wireless and GPS MEMS etc. Magnetic MEMS, all effect sensors, SQUID magnetometers, Optical MEMS, micromachinedfiber optic component, optical sensors, Thermal MEMS, thermo-mechanical and thermo-electrical actuators, Peltier heat pumps. Projects related to this course should be given to students (in groups) in order to promote team work and ethical values.
	14 Hours

Suggested Books:

. Soloman, S., "*Sensors Handbook",* 2 ed, CBS, Publishers, 2010, Print
2. Grimes, "*Encyclopedia of sensors"* CBS Publishers, 2007, Print
3. Mukhopadhyay, "*Smart sensors and sensing technology"*, CBS Publishers, 2008, Print
4. Saliterman, "*fundamentals of Bio-Mems and medical micro devices"*, CBS Publishers, 2006, Print
5. Julian W. Gardner, Vijay Varadan& Osama O. Awadelkarim, "*Microsensors, MEMS and Smart Devices"*, Wiley-Blackwell,
6. Donald G. Buerk, "*Biosensors: Theory and Applications"*, CRC, Print
7. Xueji Zhang, HuangxianJu& Joseph Wang, "*Electrochemical Sensors, Biosensors and their Biomedical Applications"*, Academic Press, Print

Course Title:	DIGITAL SIGNAL PROCESSING		L	T	P	Cr
Course Code:	ELE437		3	1	0	4
Course Outcome: After completion of course, the students should be able to	**CO1**	Understand the analytical tools such as Fourier transforms, Discrete Fourier transforms, Fast Fourier Transforms and Z-Transforms required for digital signal processing.				
	CO2	get familiarized with various structures of IIR and FIR systems.				
	CO3	Design and realize various digital filters for digital signal processing				
	CO4	Understand the applications of DSP in speech processing and spectrum analysis.				
	CO5	Analyze various signal processing techniques				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1,L2	L2	L3	L4	L4,L5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	2	-	-	-	1	2	-	3	2	1
CO2	3	3	2	2	3	-	-	-	3	2	1	3	1	2
CO3	3	2	3	2	3	1	1	1	3	2	2	3	3	2
CO4	3	2	3	-	1	1	1	-	3	1	2	3	2	1
CO5	3	3	3	1	2	-	-	-	3	3	2	2	2	1

Unit A	**Review of discrete time signals and systems** Overview of signals and systems, DFT–FFT using DIT and DIF algorithms, Inverse DFT-FFT using DIT and DIF algorithms, Applications, Circular Convolution. **Design and implementation of IIR filters** Design of analog filters using Butterworth and Chebyshev approximations, IIR digital filter design from analog filter using impulse invariance technique and bilinear transformations.
	14 Hours
Unit B	**Design and implementation of FIR filters** Linear phase response, Design techniques for FIR filters, Fourier series method and frequency sampling method–Design of Linear phase FIR filters using windows: rectangular, Henning and Hamming windows.
	14 Hours
Unit C	**Finite word length effects in digital filters** Fixed point arithmetic, effect of quantization of the input data due to Finite word length. Product round off, need for scaling, Zero input limit cycle oscillations - Limit cycle oscillations due to overflow of adders, Table lookup implementation to avoid multiplications.
	13 Hours
Unit D	**Processor Fundamentals** Features of DSP processors – DSP processor packaging (Embodiments) – Fixed point Vs floating point DSP processor data paths – Memory architecture of a DSP processor (Von Neumann – Harvard) – Addressing modes – pipelining – TMS320 family of DSPs (architecture of C5x). Projects related to this course should be given to students (in groups) in order to promote team work and ethical values.
	14 Hours

Suggested Books:

1. John G. Proakis and Dimitris C. Manolakis, *"Digital Signal Processing Principles, Algorithms and Applications"*, Pearson Education, Fourth edition, 2007.
2. Venkataramani.B, Bhaskar.M, *"Digital Signal Processors, Architecture, Programming and Application"*, Tata McGraw Hill, New Delhi, 2003.
3. SanjitMitra, *"Digital Signal Processing, A Computer based approach*", Tata McGraw Hill, New Delhi, 2011.

Course Title:	OPTIMAL CONTROL	L	T	P	Cr
Course Code:	ELE448	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	recognize parameters of optimal control system like lagrange's multiplier, eulers method.
	CO2	analyse the use of maxima and minima functions in determining the optimal solution for a problem.
	CO3	construct optimal control-based indices using Hamilton Jacobi and Ricatii equations.
	CO4	analyse the optimality principle over time variant systems.
	CO5	analyse optimal control problems, their classification along with performance indices and selection of dynamic optimization.

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L4	L5	L4	L4

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	1	2	2	2	3	2
CO2	3	3	2	3	3	3	-	-	2	-	3	-	3	2
CO3	3	2	3	2	2	2	-	-	3	3	2	2	3	2
CO4	2	2	2	2	3	3	-	-	2	-	3	-	3	2
CO5	3	3	3	2	2	2	-	-	3	3	-	2	3	2

Unit A

Introduction and Parametric Optimization: Introduction to optimal control problems, Classification of optimal control problems, performance indices for optimal control and their selection, Dynamic optimization using calculus of variations: Lagrange multiplier, Euler Lagrange's equation for different conditions, Transversality conditions, Dynamic optimization with equality and inequality constraints

14 Hours

Unit B	**Pontryegans Max/min Principle:** Optimization using Pontryegans maximum (minimum) principles with special emphasis on Bang-Bang type system **Dynamic Programming in Continuous Time:** Developments of Hamilton Jacobi equation, Matrix Riccati equation, Optimal control based on quadratic performance indices, Linear regulator and servomechanism problem
	14 Hours
Unit C	**Dynamic programming in Discrete System:** Dynamic programming multi stage decision processes in continuous time. Principle of causality, Invariant inbedding& optimality
	13 Hours
Unit D	**Iterative Method of Optimization:** Optimization using gradient methods and interactive techniques (steepest descent), Newton Raphson and Fletcher Powell. Introduction to multivariable system and decoupling, Introduction to Optimal Filters (Kalman Filter).
	14 Hours

Suggested Books:

1. M Gopal, *"Modern Control System Theory"*, Wiley Eastern.
2. Richard C Drof& R H Bishop, *"Modern Control Systems 8th Ed"*, Addision Wesley.
3. Andrew P Sage & C C White-III, *"Optimum Systems COntrol"*, PHI.
4. B D O Anderson & B Moree, *"Optimum System Control"*, PHI.

Course Title:	Fundamental of Virtual Instrumentation	L	T	P	Cr
Course Code:	ELE436	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	exercise basics of digital image generation, processing, sampling and quantization.
	CO2	know about image transforms techniques and image enhancement techniques
	CO3	become conversant in 2-D system, spectral density function, estimation and information theory
	CO4	analyse image restoration including models, filters and digital processing
	CO5	develop process of image segmentation, image data compression and associated techniques

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

Cos	CO1	CO2	CO3	CO4	CO5
RBTL No.	L3	L2	L3	L4	L6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3	-	2	-	2	-	-	-	1	2	-	2	3	2
CO2	3	3	2	2	3	1	-	-	2	3	2	2	3	3
CO3	2	-	2	3	2	-	-	1	2	3	2	2	3	3
CO4	2	2	2	-	3	2	-	-	2	2	3	3	3	3
CO5	2	2	3	3	3	1	-	-	2	3	3	3	3	3

Unit A

Introduction to Virtual Instrumentation: Historical perspective, Classification of different instruments / instrumentation system, Definition and architecture of virtual instrumentation system, salient features and application area of virtual instrumentation.

14 Hours

Unit B	**Data Flow Programming Techniques:** Graphical programming in data flow, comparison with conventional programming, popular data flow and VI software packages. Building a VI front panel and block diagram, sub VI, for and while loops, case and sequence structure, formula nodes, local and global, string and file I/O, array and clusters, charts and graphs, attributes nodes.
	13 Hours
Unit C	**Data Acquisition Basics:** ADC, DAC, D/O, counters and timer, PC hardware structure, timing, interrupts, DMA, software and hardware installation, Configuring data acquisition hardware using the drives in application software, use of DAQ library functions for different analog and digital input/output operations. **Common Instrument Interfaces:** Current loop, RS 232, RS485, GBIP. Use of library functions to communicate with different instruments.
	13 Hours
Unit D	**Use of Measurement Analysis Tools:** Measurement of Max, Min, Peak-Peak voltage, Mathematical tools, time period of a signal, power spectrum and logging Fourier transform, Correlation methods, windowing and filtering. **Building a web-based virtual instrument:** Networking basics for office and industry application.
	14 Hours

Suggested Books:

1. Gupta S., "*Virtual Instrumentation Using Labview"*, TMH publication
2. Gupta S. & Gupta J., "*PC Interfacing for data acquisition"*, SA publication
3. Wells Lisa K, Travis Jeffry, "*LabVIEW for everyone"*, PHI publication
4. Johnson Gary W, "*Lab view Graphical Programming"*, McGraw Hill

Course Title:	COMPUTATIONAL ELECTROMAGNETICS	L	T	P	Cr
Course Code:	ELE449	3	1	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	Understand the basic concepts of Electrostatics and Electromagnetics.
	CO2	Understand various computational techniques for computing magnetic fields
	CO3	Apply the differential and non-differential techniques to various time dependent problems
	CO4	analyse the analytical techniques for various irregular geometries.
	CO5	develop the knowledge of harmonic field plots, structural computations and transient fields.

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L4	L5	L4	L4

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3	3	3	2	2	-	-	-	1	2	2	2	3	2
CO2	3	3	2	3	3	3	-	1	2	-	3	-	3	2
CO3	3	2	3	2	2	2	-	-	3	3	2	2	3	2
CO4	2	2	2	2	3	3	-	1	2	-	3	-	3	2
CO5	3	3	3	2	2	2	-	-	3	3	-	2	3	2

Unit A

Introduction

Conventional design methodology, Computer-aided design aspects – Advantages. Review ofbasic fundamentals of Electrostatics and Electromagnetics. Development of Helmholtz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic

14 Hours

Unit B	**Analytical Methods** Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images. **Finite Difference Method (FDM)** Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence
	14 Hours
Unit C	**Finite Element Method (FEM)** Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations. **Special Topics** {Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)}, hybrid methods, coupled circuit - field computations, electromagnetic - thermal and electromagnetic - structural coupled computations, solution of equations, method of moments, Poisson's fields.
	13 Hours
Unit D	**Applications** Low-frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators. CAD packages.
	14 Hours
Suggested Books:	

1. P. P. Silvester and R. L. Ferrari "*Finite Element for Electrical Engineers*", Cambridge University press, 1996.
2. M. N. O. Sadiku, "*Numerical Techniques in Electromagnetics*", CRC press, 2001.

Course Title:	ELECTRICAL ENGINEERING MATERIALS	L	T	P	Cr
Course Code:	ELE450	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	acquire an in-depth knowledge about the conducting materials
	CO2	acquire of knowledge of properties of dielectric and insulator materials.
	CO3	understand the selection of magnetic materials for electrical devices
	CO4	acquire the knowledge of materials for special applications in electrical equipment
	CO5	to understand the processes used in Plano technology

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L4	L2,L5	L1, L4	L3	L2, L5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3	3	3	2	2	-	-	-	1	2	2	2	2	2
CO2	3	3	2	3	3	3	-	-	2	-	3	-	2	2
CO3	3	2	3	2	2	2	-	-	3	3	2	2	1	2
CO4	2	2	2	2	3	3	3	-	2	-	3	-	1	2
CO5	3	3	3	2	2	2	-	-	3	3	-	2	2	2

Unit A

Conductors, Properties of conductors, ACSR, High resistivity materials and their properties, Alloys, Soldering and brazing materials, superconductivity, superconductor materials and their applications.

14 Hours

Unit B	Insulators, classifications of insulators, dialectical materials, glass and ceramics refractory materials and their uses, optical fibers, laser and optoelectronics materials, semiconductor materials, properties of semiconductor materials thermosetting and thermoplastic materials.
	13 Hours
Unit C	Classification of material, Dia, Para, and Ferromagnetic materials-curie law and Curie Weiss law (qualitative study). Ferromagnetism-Qualitative study of domain theory – Hysteresis phenomena. Hard and soft magnetic material and their applications. Ferrites, Structure and property.
	14 Hours
Unit D	Processes used in Plano technology e.g. Lapping, polishing, cleaning, masking, photolithography, diffusion, oxidation and metallization, welding wire bonding, packaging and encapsulation, Heating induction and dielectric, Electron beam welding and cutting annealing, cold &Hot rolling.
	14 Hours

Suggested Books:

1. Kasap S.O, "*Principles of Electrical Engg. Material and Devices*" MGH.
2. Mahajan, "*Principles of Growth and processing of semiconductors*" MGH.
3. Dhir, " *Electronics components and materials and Principles Manufacturing & Maintenance*"
4. Addision, "*Electronics Engg. Material Devices*" TMH.
5. Ruska N Scot, "*Microelectronics processing and introduction to the manufacturer of integrated circuits*", MGH.
6. Seth & Gupta, "*A course in Electrical Engg. Material*" DhanpatRai& Sons.
7. Dekker, "*Electrical Engg. Materials*"PHI.

Course Title:	ADVANCED INSTRUMENTATION		L	T	P	Cr
Course Code:	ELE468		4	0	0	4
Course Outcome: After completion of course, the students should be able to	CO1	acquire an in-depth knowledge about the wave analysers and various measuring instruments.				
	CO2	acquire of knowledge of properties and working of intelligent sensors like vision sensor, microwave sensor.				
	CO3	understand the selection criteria of optical fibre sensors, their properties and applications				
	CO4	recognize the importance of sound frequencies and light intensities.				
	CO5	acquire the knowledge of tactile sensors				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L4	L5	L4	L4

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3	3	3	2	2	-	-	-	1	2	2	2	3	2
CO2	3	3	2	3	3	3	-	1	2	-	3	-	3	2
CO3	3	2	3	2	2	2	-	-	3	3	2	2	3	2
CO4	2	2	2	2	3	3	-	1	2	-	3	-	3	2
CO5	3	3	3	2	2	2	-	-	3	3	-	2	3	2

Unit A

Electronic Measuring Instruments: Advanced semescope and displays, high-speed oscilloscope, sampling oscilloscope ,DSO wave analyzer, distortion analyzer, modulation analyzer, spectrum analyzer, wavemeter, digital phase meter, frequency synthesizers, logic state analyzer, LCR meters.

14 Hours

Unit B	**Advanced Sensors:** Current and voltage sensors, intelligent pressure transducer, turbidity measurement, microwave sensor, ceramic sensor as gas sensor. **Vision Sensors**: overview, illumination consideration, vision sensors generalties, 2D sensor, 3D sensor, interfacing of vision sensors.
	13 Hours
Unit C	**Optical Fibre Sensor:** Introduction, extrinsix and dynamic fibre optic sensor, elementary principles, the design of optical fibre sensor, development of optical fibre sensor, phase modulated optical fibre sensor, frequency modulation in optical sensor, polarization modulation in fiber sensors, distributed optical fiber sensing DOFS, distributed micro bend strains sensor, distributed optical fibre temperature sensor, using the optical kerr effect, distributed optical fibre sensor for chemical species, fiber optic sensor for air pollution, optical fiber pressure sensor, optical fiber pressure sensor, optical fiber temperature sensor, optical fiber sensor for humidity
	14 Hours
Unit D	**Ultrasonic Instrumentation:** Sirens, whistles, the wretch whistles, liquid ultrasonic, generators, solid transducers, piezoelectric transducers, magneto strictive transducers, the production of very light intensity, depleted layer transducer, applications of ultrasonic processing, uses of ultrasonic in measurement and control, flow detection, application of ultrasonic to boilers. **Tactile Sensors:** Overview, touch sensing, tactile sensing, interfacing of tactile sensors**.**
	14 Hours

Suggested Books:

Allan Morris, "*Principles of measurement and instrumentation*", PHI.
2. J P Bartley, "*Principles of measurement system*", Longman London
3. SabrieSoloman, "*Sensors and control system in manufacturing*", McGraw Hill.
4. HKP Newbert, "*Instrument transducer*", Clarendon.
5. Cooper and Helfrick, "*modern electronic instrumentation and measurement techniques*", PHI.

Course Title:	Electrical and Hybrid Vehicles		L	T	P	Cr
Course Code:	ELE459		4	0	0	4
Course Outcome: After completion of course, the students should be able to	CO1	**Understanding** Conventional Vehicles:				
	CO2	Configuration and control of DC/AC Motor drives				
	CO3	Energy Storage Requirements in Hybrid and Electric Vehicles				
	CO4	Energy management strategies used in hybridand electric vehicles				
	CO5	**Case studies**				

Unit A

Introduction

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

14 Hours

Unit B

Electric Trains

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drivetrain topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control ofInduction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

15 Hours

Unit C

Energy Storage

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery-based energy storage and its analysis, Fuel Cell-based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel-based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

12 Hours

Unit D	**Energy Management Strategies** Energy Management Strategies: Introduction to energy management strategies used in hybridand electric vehicles, classification of different energy management strategies, comparison ofdifferent energy management strategies, implementation issues of energy management strategies. **Case Studies:** Design of a Hybrid Electric Vehicle (HEV), Design of a Battery ElectricVehicle (BEV).
	14 Hours

Suggested Books:

. . C. Mi, M. A. Masrur and D. W. Gao, "*Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives*", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "*Hybrid Electric Vehicles: Energy Management Strategies*", Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "*Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design*", CRC Press, 2004.
4. T. Denton, "*Electric and Hybrid Vehicles*", Routledge, 2016.

Course Title:	NEURAL NETWORKS AND FUZZY LOGICS	L	T	P	Cr
Course Code:	ELE460	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	Introductory knowledge of Expert system
	CO2	Expert systems, fuzzy sets and control theory
	CO3	Introduction, Reasoning models,
	CO4	Rule Base Construction By Self- Learning
	CO5	Fuzzy Controller With Self Learning Teacher:

Unit A	**Introduction:** Expert systems, fuzzy sets and control theory; representation, reasoning and acquisition; inference engines and functions approximator, model-based and training based fuzzy control; neural networks and fuzzy systems; fuzzy-neural control: ideas & para-diagrams
	14 Hours
Unit B	**Approximate Reasoning Approach:** Introduction, Reasoning models, rule aggregation and operator selection, reasoning with uncertain data and rules, architecture of multivariable fuzzy control
	13 Hours
Unit C	**Rule Base Construction By Self- Learning:** Description of system structure, proposed learning algorithm, convergence analysis, error and derivative correction, fuzzy control algorithm, extracting rules from recorded data
	14 Hours
Unit D	**Fuzzy Controller With Self Learning Teacher:** Formulation of the problem, solution using neural networks (BNN network, isomorphic mapping of functionality), BNN based fuzzy controller, learning & rules extracting, hybrid neural network, system structure, dynamical self organizing, adaptive mechanisms, simplified fuzzy control algorithms, representation and reasoning by CPN, self construction of rule base, description of the CMAC and RBF, connecting the CMAC and RBF to the SFCA, self construction of the fuzzified network based controller
	15 Hours

Suggested Books:

. J.M.Zurada, "*Introduction to Neural Systems*", Jaico Publishers.
2. Dr. V.B.Rao and Sh. H.V. Rao, "*Neural Networks and Fuzzy Logic*", BPB Publications.
3. JunhongNie and DeretLinkens, "*Fuzzy- Neural Control: Principles, Algorithms and Applications*", PHI Publications.
4. Rao & Rao, "*C++ Neural Network and fuzzy logic*", M&T books.

Course Title:	ELECTRICAL ENERGY AUDITING AND DEREGULATION	L	T	P	Cr
Course Code:	ELE408	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	Types of energy audit, Energy management (audit) approach-understanding energy costs
	CO2	**Need and advantage of de regulation**
	CO3	Power wheeling in Multi area system
	CO4	Reactive power management in some deregulated electricity markets
	CO5	**Reliability Analysis**

Unit A	**Energy Management & Audit:** Definition, Energy audit-need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Benchmarking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments
	14 Hours
Unit B	**Deregulation:** Introduction, Reconfiguring Power systems, unbundling of electric utilities, Background to deregulation and the current situation around the world, benefits from a competitive electricity market after effects of deregulation, Role of the independent system operator, Operational planning activities of ISO: ISO in Pool markets, ISO in Bilateral markets, Operational planning activities of a GENCO: Genco in Pool and Bilateral markets, market participation issues, competitive bidding
	13 Hours
Unit C	Power wheeling, Transmission open access, pricing of power transactions, security management in deregulated environment, and congestion management in deregulation, General description of some ancillary services, ancillary services management in various countries, reactive power management in some deregulated electricity markets
	14 Hours
Unit D	**Reliability analysis:** interruption criterion, stochastic components, component models, Calculation methods, Network model: stochastic networks, series and parallel connections, minimum cut sets, reliability cost, Generation, transmission and distribution reliability, Reliability and deregulation: conflict, reliability analysis, effects on the actual reliability, regulation of the market
	14 Hours
Suggested Books:	

. K. Bhattacharya, MHT Bollen and J.C Doolder, "*Operation of Restructured Power Systems*", Kluwer Academic Publishers, USA, 2001.
2. Lei Lee Lai, "*Power System restructuring and deregulation*", John Wiley and Sons, UK. 2001.
3. Fred I Denny and David E. Dismukes "*Power System Operations and Electricity Markets*", CRC Press, LLC, 2002.

Course Title:	POWER QUALITY AND FACTS	L	T	P	Cr
Course Code:	ELE461	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	Transmission Lines and Series/Shunt Reactive Power Compensation
	CO2	Thyristor-based Flexible AC Transmission Controllers (FACTS
	CO3	Voltage Source Converter based (FACTS) controllers
	CO4	Application of FACTS
	CO5	Power Quality Problems in Distribution Systems

Unit A

Transmission Lines and Series/Shunt Reactive Power Compensation
Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Thyristor-based Flexible AC Transmission Controllers (FACTS)
Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator
(SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

14 Hours

Unit B

Voltage Source Converter based (FACTS) controllers
Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter

13 Hours

Unit C

Application of FACTS
Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

Power Quality Problems in Distribution Systems
Power Quality problems in distribution systems: Transient and Steady-state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance
of Equipment: CBEMA curve.

15 Hours

Unit D	**DSTATCOM** Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM. **Dynamic Voltage Restorer and Unified Power Quality Conditioner** Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.
	14 Hours

Suggested Books:

. N. G. Hingorani and L. Gyugyi, "*Understanding FACTS: Concepts and Technology of FACTS Systems*", Wiley-IEEE Press, 1999.
2. K. R. Padiyar, "*FACTS Controllers in Power Transmission and Distribution*", New Age International (P) Ltd. 2007.
3. T. J. E. Miller, "*Reactive Power Control in Electric Systems*", John Wiley and Sons, New York, 1983.
4. R. C. Dugan, "*Electrical Power Systems Quality*", McGraw Hill Education, 2012.
5. G. T. Heydt, "*Electric Power Quality*", Stars in a Circle Publications, 1991

Course Title:	OPTIMIZATION TECHNIQUES	L	T	P	Cr
Course Code:	ELE435	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	Introduction of optimization and constraints
	CO2	Linear Programming approach
	CO3	Constrained Optimization Techniques:
	CO4	Unconstrained Multivariable Optimization Techniques:
	CO5	Multiobjective Optimization Techniques

Unit A	**Introduction to optimization:** Statement of an optimization problem, Classification of optimization problems, Optimization techniques, Engg. applications of optimization. **Classical optimization techniques:** Single variable optimization, Multivariable optimization with no constraints, Multivariable optimization with equality constraints, Multivariable optimization with inequality constraints.
	14 Hours
Unit B	**Linear programming:** Standard form of linear programming, Graphical solution, Simplex method, Twophase simplex method, Computer implementation of the simplex method, Duality theory. **Transportation problem:** North-West Corner rule, Least cost method, Vogel approximation method, testing for optimality.
	13 Hours
Unit C	**Non-linear programming:** **One–Dimensional Minimization Methods**: Unimodal function, Dichotomous search, Fibonacci search, Golden Section, Cubic interpolation method, Direct root, Newton Raphson Method **Unconstrained Multivariable Optimization Techniques:** Random search method, Steepest descent method, Conjugate gradient method, Variable metric method. Newton Raphson Method, Evolutionary search, Hooke-Jeeves Method, Simplex search Method **Constrained Optimization Techniques:** Interior Penalty function method, Exterior penalty function method, Method of Multipliers, KKT Conditions
	14 Hours
Unit D	**Further topics in optimization:** Critical path method (CPM), Program evaluation and review technique (PERT). Multiobjective Optimization Techniques, Weighting method, ε-constraint method. Simulated annealing method
	14 Hours

Suggested Books:	

Rao, S.S., "*Optimization : Theory and Application"* , Wiley Eastern Press, 2nd edition 1984.
2. Deb Kalyanmoy,. "*Optimisation for Engineering Design-Algorithms and Examples"*., Prentice Hall India-1998
3. Taha,H.A., "*Operations Research -An Introduction*" ,Prentice Hall of India,2003.
4. Fox, R.L., "*Optimization methods for Engineering Design*", Addition Welsey, 1971.
5. Ravindran A., Ragsdell K.M. and Reklaitis G.V. , "*Engineering Optimization: Methods And applications"* , Wiley, 2008
6. Godfrey C. Onwubolu , B. V. Babu , "*New optimization techniques in engineering"* , Springer, 2004

Course Title:	POWER SYSTEM DYNAMICS AND CONTROL	L	T	P	Cr
Course Code:	ELE463	3	1	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	Choose the fundamental dynamic behaviour and controls of power systems to perform basic stability analysis.
	CO2	Comprehend concepts in modelling and simulating the dynamic phenomena of power systems Interpret results of system stability studies
	CO3	analyse theory and practice of modelling main power system components.
	CO4	explain the connection between frequency and active power and between voltage and reactive power
	CO5	analyse the tools for enhancing system stability.

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1,L2	L2,L3	L4	L5	L4,L5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	1	2	1	1	2	-	3	2	1
CO2	3	2	2	2	3	-	-	1	3	2	2	3	3	2
CO3	3	2	2	-	3	1	1	1	3	2	1	3	3	2
CO4	3	2	1	1	2	2	3	3	3	2	2	3	2	1
CO5	3	3	3	2	3	1	1	2	3	3	1	2	2	1

Introduction to Power System Operations

Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

Analysis of Linear Dynamical System and Numerical Methods

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysis using Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

		14 Hours
Unit B	**Modeling of Synchronous Machines and Associated Controllers** Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.	
		13 Hours
Unit C	**Modeling of other Power System Components** Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems. **Stability Analysis** Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multimachine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor drop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools:Transient Stability Programs, Small Signal Analysis Programs.	
		15 Hours
Unit D	**Enhancing System Stability** Planning Measures. Stabilizing Controllers (Power System Stabilizers). Operational Measures-Preventive Control. Emergency Control. Projects related to this course should be given to students (in groups) in order to promote team work and ethical values.	
		14 Hours

Suggested Books:

. K.R. Padiyar, "*Power System Dynamics, Stability and Control*", B. S. Publications, 2002.
2. P. Kundur, "*Power System Stability and Control*", McGraw Hill, 1995.
3. P. Sauer and M. A. Pai, "*Power System Dynamics and Stability*", Prentice Hall, 1997.

Course Title:	INDUSTRIAL ELECTRICAL SYSTEMS	L	T	P	Cr
Course Code:	ELE464	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	Basics about electrical equipment's in manufacturing
	CO2	Application of electrical equipment's in different types of industries
	CO3	Types and working of electric traction systems
	CO4	Industry oriented consumption of electrical energy
	CO5	Basics about Illumination and its types

Unit A	**Electrical System Components** LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.	**14 Hours**
Unit B	**Residential and Commercial Electrical Systems** Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components. **Illumination Systems** Understanding various terms regarding light, lumen, intensity, candlepower, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.	**14 Hours**

Unit C	**Industrial Electrical Systems I** HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components. **Industrial Electrical Systems II** DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.
	13 Hours
Unit D	**Industrial Electrical System Automation** Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.
	14 Hours

Suggested Books:

1. S. L. Uppal and G. C. Garg, "*Electrical Wiring, Estimating &Costing*", Khanna publishers, 2008.
2. K. B. Raina, "*Electrical Design, Estimating & Costing*", New age International, 2007.
3. S. Singh and R. D. Singh, "Electrical estimating and costing", DhanpatRai and Co., 1997.
4. Web site for IS Standards.
5. H. Joshi, "*Residential Commercial and Industrial Systems*", McGraw Hill Education, 2008.

Course Title:	ADVANCED ELECTRIC DRIVES	L	T	P	Cr
Course Code:	ELE465	3	1	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	Design controllers for closed-loop operation of a separately excited DC motor drive with symmetrical optimization technique
	CO2	Implement sine-triangle and Space Vector PWM techniques on analog and digital platforms
	CO3	Understand the power circuit topologies and the sine triangle PWM technique for 3-level NPC, FC, HB inverters
	CO4	Understand and simulate the behavior of high performance induction Motor drives using the principles of Vector Control and DTC
	CO5	Understand and apply the concept of vector control to PMSM drives

Unit A	**Power Converters for AC Drives** PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three-level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.	**14 Hours**
Unit B	**Induction motor drives** Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC).	**13 Hours**
Unit C	**Synchronous motor drives** Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives. **Permanent magnet motor drives** Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.	**14 Hours**

Unit D	**Switched reluctance motor drives** Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM. **DSP based motion control** Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.
	14 Hours

Suggested Books:

. B. K. Bose, "*Modern Power Electronics and AC Drives*", Pearson Education, Asia, 2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, "*Analysis of Electric Machinery and Drive Systems*", John Wiley & Sons, 2013.
3. H. A. Taliyat and S. G. Campbell, "*DSP based Electromechanical Motion Control*", CRC press, 2003.
4. R. Krishnan, "*Permanent Magnet Synchronous and Brushless DC motor Drives*", CRC Press, 2009.

Course Title:	CONTROL SYSTEMS DESIGN		L	T	P	Cr
Course Code:	ELE467		3	1	0	4
Course Outcome: After completion of course, the students should be able to	**CO1**	Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form				
	CO2	Formulate different types of analysis in frequency domain to explain the nature of stability of the system.				
	CO3	solve the steady state and transient analysis of a system for standard inputs.				
	CO4	analyse feedback control mechanisms and design feedback control systems				
	CO5	Understand the impact of PID and lead/lag compensation techniques on system performance, stability, and disturbance rejection				

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L4	L5	L4	L4

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO 1	PO2	PO3	PO 4	PO5	PO6	PO 7	PO8	PO9	PO1 0	PO1 1	PO 12	PSO 1	PS O2
CO1	3	3	3	2	2	-	-	-	1	1	2	2	3	2
CO2	3	3	2	3	3	1	-	1	2	-	3	-	3	2
CO3	3	2	3	2	2	1	-	-	3	2	2	2	3	2
CO4	2	2	2	2	3	-	-	-	2	-	3	-	3	2
CO5	3	3	3	2	2	-	1	-	3	3	-	2	3	2

Unit A	**Design Specifications** Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.
	14 Hours
Unit B	**Design of Classical Control System in the time domain** Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feedforward compensator design. Feedback compensation. Realization of compensators.
	13 Hours
Unit C	**Design of Classical Control System in frequency domain** Compensator design in frequency domain to improve steady state and transient response. Feedback and Feedforward compensator design using bode diagram. **Design of PID controllers** Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feedforward control.
	14 Hours
Unit D	**Control System Design in state space** Review of state space representation. Concept of controllability & observability, effect of pole-zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation Principle. **Nonlinearities and its effect on system performance** Various types of non-linearities. Effect of various non-linearities on system performance. Singular points. Phase plot analysis.
	14 Hours

Suggested Books:

. N. Nise, "*Control system Engineering*", John Wiley, 2000.
2. I. J. Nagrath and M. Gopal, "*Control system engineering*", Wiley, 2000.
3. M. Gopal, "*Digital Control Engineering*", Wiley Eastern, 1988.
4. K. Ogata, "*Modern Control Engineering*", Prentice Hall, 2010.
5. B. C. Kuo, "*Automatic Control system*", Prentice Hall, 1995.
6. J. J. D'Azzo and C. H. Houpis, "*Linear control system analysis and design (conventional and modern)*", McGraw Hill, 1995.
7. R. T. Stefani and G. H. Hostetter, "*Design of feedback Control Systems*", SaundersCollege Pub, 1994

Course Title:	ADVANCED INSTRUMENTATION	L	T	P	Cr
Course Code:	ELE468	4	0	0	4

Course Outcome: After completion of course, the students should be able to		
	CO1	Describe general principles and procedures involved in **Electronic Measuring Instruments**
	CO2	Learn basic principles and instrumentation of thermal analysis
	CO3	Learn basic knowledge about the calibration of analytical instruments
	CO4	Understand the effects of different constituent in a process outcome and analysis the performance of various on-line or off-line instruments
	CO5	Apply the knowledge of **Tactile Sensors**

RBTL No. Mapping:

L1(Remembering), L2(Understanding), L3(Applying), L4(Analysing), L5(Evaluating), L6(Creating)

COs	CO1	CO2	CO3	CO4	CO5
RBTL No.	L1, L2	L4	L5	L4	L4

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):

COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	1	1	2	2	3	2
CO2	3	3	2	3	3	1	-	1	2	-	3	-	3	2
CO3	3	2	3	2	2	1	-	-	3	2	2	2	3	2
CO4	2	2	2	2	3	-	-	1	2	-	3	-	3	2
CO5	3	3	3	2	2	-	1	-	3	3	-	2	3	2

Unit A

Electronic Measuring Instruments: Advanced semescope and displays, high-speed oscilloscope, sampling oscilloscope ,DSO wave analyzer, distortion analyzer, modulation analyzer, spectrum analyzer, wavemeter, digital phase meter, frequency synthesizers, logic state analyzer, LCR meters.

14 Hours

Unit B	**Advanced Sensors:** Current and voltage sensors, intelligent pressure transducer, turbidity measurement, microwave sensor, ceramic sensor as gas sensor. **Vision Sensors**: overview, illumination consideration, vision sensors generalties, 2D sensor, 3D sensor, interfacing of vision sensors.
	14 Hours
Unit C	**Optical Fibre Sensor:** Introduction, extrinsix and dynamic fibre optic sensor, elementary principles, the design of optical fibre sensor, development of optical fibre sensor, phase modulated optical fibre sensor, frequency modulation in optical sensor, polarization modulation in fiber sensors, distributed optical fiber sensing DOFS, distributed micro bend strains sensor, distributed optical fibre temperature sensor, using the optical kerr effect, distributed optical fibre sensor for chemical species, fiber optic sensor for air pollution, optical fiber pressure sensor, optical fiber pressure sensor, optical fiber temperature sensor, optical fiber sensor for humidity.
	13 Hours
Unit D	**Ultrasonic Instrumentation:** Sirens, whistles, the wretch whistles, liquid ultrasonic, generators, solid transducers, piezoelectric transducers, magnetostrictive transducers, the production of very light intensity, depleted layer transducer, applications of ultrasonic processing, uses of ultrasonic in measurement and control, flow detection, application of ultrasonic to boilers. **Tactile Sensors:** Overview, touch sensing, tactile sensing, interfacing of tactile sensors**.**
	14 Hours

Suggested Books:

. Allan Morris, "*Principles of measurement and instrumentation*", PHI.
2. J P Bartley, "*Principles of measurement system*", Longman London
3. SabrieSoloman, "*Sensors and control system in manufacturing*", McGraw Hill.
4. HKP Newbert, "*Instrument transducer*", Clarendon.
5. Cooper and Helfrick, "*modern electronic instrumentation and measurement techniques*", PHI.

Course Title:	POWER PLANT ENGINEERING		L	T	P	Cr
Course Code:	ELE407		4	0	0	4
Course Outcome: After completion of course, the students should be able to	CO1	Understand the Steam Generators, Condensers And Turbines and Steam Power Plant				
	CO2	Gain the knowledge regarding Equipment, Plant layout, principle of working of Hydro Power plant				
	CO3	Familiarize the working principles of Nuclear Power Plants				
	CO4	Understand the various diesel and gas turbine plants				
	CO5	Basic knowledge of Combined operation of Different types of *Power Plants*, and pollution control				

Unit A	**Steam Generators, Condensers And Turbines:** Classification of steam generators, selection, operation of locomotive, Babcock Wilcox, Cochran boilers, Types of condensers, effect of air in condensers, Dalton's law of partial pressure, cooling water calculations, steam nozzles, types of steam turbine efficiencies, compounding, governing and control. **Steam Power Plant:** Classification, Operation, Description of Rankin cycle, Regenerative cycle, Reheat-Regenerative Cycle, Binary Vapour Cycle, Selection of plant site and its layout, coal handling system, combustion system, Fluidised bed combustion, Ash handling, Feed pumps, Heat exchangers, Economizers, Superheaters, Reheaters, Air preheaters, Feed water heaters, Evaporators.	**14 Hours**
Unit B	**Hydro-Electric Power Plants:** Hydrological Cycle, Hydrograph, Flow duration curve,Selection of site, Essential features, Classification of hydro plants, base and peak load plant, pumped storage plant. Run of river with and without pondage. Selection of water turbines for hydropower plant, Automatic and remote control of hydro-station, layout of hydropower plant. **Nuclear Power Plants:** Nuclear physics, Binding energy, Radioactive decay. Fertile material, Mass defect, Nuclear reactions type and application, Generation of nuclear energy by fission, Nuclear reactors. Site selections, safety measures, plant layout, Fusion reaction, Future of nuclear power.	**13 Hours**
Unit C	**Gas Turbine:** Elements of gas turbines, Open and closed cycles for gas turbines, Performance terms, Thermal refinement to gas turbines cycle, Plant layout, applications, gas turbines Cycle calculations. **Diesel Power Plants:** Classifications of IC Engines and their performance, Four stroke and two-stroke diesel engines, combustion phenomenon; Essential components, Celane number, knocking, supercharging, operation and layout of diesel power plant.	**14 Hours**

Unit D	**Combined Operation Of Different Power Plants**: Advantages of combined operation of plants, load division between power stations, coordination of different types of Power Plants. **Pollution Control**: Pollution from thermal & nuclear plants, Particulate emission and control, electrostatic precipitator, solid waste disposal.
	14 Hours

Suggested Books:

Chakrabarti A., Soni, M.L. Gupta P.V. and Bhatanagar U.S., "*A Textbook on PowerSystem Engineering",* DhanpatRai& Co.

1. EI-Wakit M.M., "*Power Plant Engineering"*, McGraw Hill, USA
2. Rajput R.K., "*Power Plant Engineering"*, Luxmi Publications
3. Sharma P.C., "*Power Plant Engineering"*, Kataria& Sons
4. Skrotzki B.G.A. and Vapot W.A., "*Power Station Engineering and Economy"*, Tata McGraw-Hill