Velagapudi Ramakrishna Siddhartha Engineering College: Vijayawada - 7
Scheme of Instruction and Examination – VR14

Group – A (CE, EEE, EIE and ME)
Semester I

	Sub. Code	Subject Title	L	T	P	C	CE	SE	TM
1	14MA1101	Linear Algebra and Differential Equations	4	1		4	30	70	100
2	14CH1102	Engineering Chemistry	3	1		3	30	70	100
3	14CS1103	Introduction to Computing	2			2	30	70	100
4	14CE1104	Basics of Civil Engineering	4			4	30	70	100
5	14HS1105	Professional Ethics	2			2	30	70	100
6	14ME1106	Basics of Mechanical Engineering	2			2	30	70	100
7	14ME1107	Mechanics for Engineers	2			2	30	70	100
8	14CH1151	Engineering Chemistry Lab			3	2	30	70	100
9	14CS1152	Basic Computing Lab			3	2	30	70	100
10	14ME1153	Workshop Practice			3	2	30	70	100
		Total	**19**	**2**	**9**	**25**	300	700	1000

Semester II

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	TM
1	14MA1201	Calculus	4	1		4	30	70	100
2	14PH1202	Engineering Physics	3	1		3	30	70	100
3	14CS1203	Programming in C	3	1		3	30	70	100
4	14HS1204	Technical English and Communication Skills	2		2	2	30	70	100
5	14EE1205	Basics of Electrical Engineering (Only for EEE and EIE)	2			2	30	70	100
6	14EC1206	Basics of Electronics Engineering (Only for EEE and EIE)	2			2	30	70	100
7	14PH1251	Engineering Physics lab			3	2	30	70	100
8	14CS1252	Programming in C Lab			3	2	30	70	100
9	14ME1253	Engineering Graphics	2		6	5	30	70	100
		Total	**18**	**3**	**14**	**25**	**270**	**630**	**900**

L – Lecture, T – Tutorial, P – Practical, C – Credits, **CE - Continuous Evaluation, SE - Semester-end Evaluation, TM – Total Marks**

Semester III

	Sub. Code	Subject Title	L	T	P	C	CE	SE	TM
1	14MA1301	Complex Analysis & Numerical Methods (IC)	4	1	-	4	30	70	100
2	14EE3302	Electronic circuits-I	4	-	-	4	30	70	100
3	14EE3303	Network Analysis-I	4	1	-	4	30	70	100
4	14EE3304	Digital circuits and systems	3	-	-	3	30	70	100
5	14EE3305	DC Machines	4	1	-	4	30	70	100
6	14EN1306	Environmental Studies*	3	-	-	3	30	70	100
7	14EE3351	Electrical Networks & Machines Lab-I	-	-	3	2	30	70	100
8	14EE3352	Electronics Lab -I	-	-	3	2	30	70	100
		Total	**22**	**3**	**6**	**26**	**240**	**560**	**800**

Semester IV

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	TM
1	14MA1401	Transformations and Probability Distribution	3	1	-	3	30	70	100
2	14EE3402	Electronic circuits-II	3	-	-	3	30	70	100
3	14EE3403	EMF Theory	3		-	3	30	70	100
4	14EE3404	Network Analysis-II	4	1	-	4	30	70	100
5	14EE3405	Transformers and Induction Motors	4	1	-	4	30	70	100
6	14EE3406	Electrical Measurements	3	1	-	3	30	70	100
7	14EE3451	Electrical Networks and Machines Lab-II	-	-	3	2	30	70	100
8	14EE3452	Electrical Measurements Lab	-	-	3	2	30	70	100
9	14EE1453	Communication Skills Lab	-	-	2	2	30	70	100
Total			**20**	**4**	**8**	**26**	**270**	**630**	**900**

L – Lecture, T – Tutorial, P – Practical, C – Credits, **CE - Continuous Evaluation, SE - Semester-end Evaluation, TM – Total Marks.**

Semester V

	Sub. Code	Subject Title	L	T	P	C	CE	SE	TM
1	14EE3501	Linear Control Systems	3	1	-	3	30	70	100
2	14EE3502/14EI3502	Integrated circuits & Applications	3	1	-	3	30	70	100
3	14EE3503	Microcontrollers & Digital Signal Processors	3	1	-	3	30	70	100
4	14EE3504	Synchronous & Special Machines	3	1	-	3	30	70	100
5	14EE2505	Institutional Elective*	4	-	-	4	30	70	100
	14EE2505/1	Generation And Utilization Of Energy							
	14EE2505/2	Energy Auditing							
	14EE2505/3	Renewable Energy Systems							
	14EE2505/4	Solar Photovoltaic							
6	14EE5506	Independent Learning (MOOCs)	3	-	-	3	30	70	100
	14EE5506A	Course A –Illumination Engineering							
	14EE5506B	Course B – Power Electronics and Distributed Generation							
7	14EE3507	Power Systems-I	3	-	-	3	30	70	100
8	14EE3551	AC Machines Lab	-	-	3	2	30	70	100
9	14EE3552	Electronics and Workshop Lab-II	-	-	3	2	30	70	100
		Total	**22**	**4**	**6**	**26**	**270**	**630**	**900**

L – Lecture, T – Tutorial, P – Practical, C – Credits, **CE - Continuous Evaluation, SE - Semester-end Evaluation, TM – Total Marks.**

Semester VI

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	TM
1	14EE3601	Fundamentals of Digital Signal Processing	4	1	-	4	30	70	100
2	14EE3602	Power Electronics	4	1	-	4	30	70	100
3	14EE3603	Advanced Control Systems	3	1	-	3	30	70	100
4	14HS1604	Engineering Economics and Finance (Institutional Core)	3	-	-	3	30	70	100
5	14EE3605	Power Systems - II	3	1	-	3	30	70	100
6	14EE3651	DSP Lab	-	-	3	2	30	70	100
7	14EE3652	Control Systems & Microcontroller Lab	-	-	3	2	30	70	100
8	14EE3653	Term Paper	-	1	-	2	30	70	100
		Total	**17**	**5**	**6**	**23**	**240**	**560**	**800**

Semester VII

	Sub. Code	Subject Title	L	T	P	C	CE	SE	TM
1.	14EE3701	Utilization of Electric Power	3	1		3	30	70	100
2.	14EE3702	Switch Gear and Protection	3	1		3	30	70	100
3.	14EE3703	Power System Analysis	3	1		3	30	70	100
4.	14EE3704	Industrial Drives	4	1		4	30	70	100
5.	14EE4705	Program Elective – I	3	1		3	30	70	100
	14EE4705/1	HVDC Transmission							
	14EE4705/2	Computer Networks							
	14EE4705/3	Optimization Techniques							
	14EE4705/4	Internet of Things							
6.	14EE4706	Program Elective – II	3	1		3	30	70	100
	14EE4706/1	Electrical Distribution Systems							
	14EE4706/2	AI Techniques in Electrical Engineering							
	14EE4706/3	Data base Management Systems							
	14EE4706/4	VLSI Design							
7.	14EE3751	Power Systems Lab			3	2	30	70	100
8.	14EE3752	Power Electronics Lab			3	2	30	70	100
9.	14EE6753	Internship/ Industry offered Course			2	2	-	100	100
10.	14EE5754	Mini Project			1	2	30	70	100
		Total	**19**	**6**	**9**	**27**	**270**	**730**	**1000**

L– Lecture, T – Tutorial, P – Practical, C – Credits, **CE - Continuous Evaluation, SE - Semester-end Evaluation, TM – Total Marks*** Two credits may be added either in 6^{th} or 7^{th} semester.

Semester VIII

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	TM
1	14EE3801	Power system operation and control	4	1	-	4	30	70	100
2	14EE4802	Program Elective – III	3	1	-	3	30	70	100
	14EE4802/1	FACTS Controllers							
	14EE4802/2	Computer Organization							
	14EE4802/3	Renewable Energy Systems							
	14EE4802/4	High Voltage Engineering							
3	14EE4803	Program Elective - IV	3	1	-	3	30	70	100
	14EE4803/1	Advanced Protection System							
	14EE4803/2	Energy Conservation and Audit							
	14EE4803/3	Electrical Machine Design							
	14EE4803/4	Smart Grid Technology And Applications							
4	14EE3851	Simulation of Electrical Systems Lab	-	-	3	2	30	70	100
5	14EE5852	Project	-	3	9	10	30	70	100
		Total	**10**	**6**	**12**	**22**	**150**	**350**	**500**

L – Lecture, T – Tutorial, P – Practical, C – Credits, **CE - Continuous Evaluation, SE - Semester- End Evaluation, TM – Total Marks**

14MA1101 - LINEAR ALGEBRA& DIFFERENTIAL EQUATIONS

Course Category:	Institutional Core	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial- Practice:**	4 -1 - 0
Prerequisites:	Fundamentals of Matrices, Integration, Differentiation.	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Understand the concept of eigen values and eigen vectors and able to reduce a quadratic form to canonical form.											
	CO2	Able to solve the linear differential equations by using appropriate methods.											
	CO3	Able to form Partial Differential equations and solve Partial Differential equations.											
	CO4	Understand the concepts of Laplace Transforms and able to apply to solve Differential Equations, Integral Equations by Transform method.											
Contribution of Course Outcomes towards achievement of Program Outcomes (M-Medium, H–High,L-Low)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	L			H		M		M			
	CO2	H	M			H		M		M			
	CO3	H	M			H		M		M			
	CO4	H	H			H		M		M			

Course Content

UNIT-I **[Text Book-1]**

Linear Algebra:

Rank of a Matrix, Elementary transformations, Inverse of a matrix (Gauss Jordan Method) Consistency of Linear System of Equations, Linear Transformations, Vectors, Eigen Values, Properties of Eigen Values, Cayley– Hamilton Theorem (Without Proof),Reduction to Diagonal Form, Reduction of quadratic form to canonical form , Nature of a Quadratic Form, Complex Matrices

UNIT-II **[Text Book - 1]**

Differential Equations of First Order:

Formation of a Differential Equation, Solution of a Differential Equation, Linear Equations, Bernoulli's Equation, Exact Differential Equations, Equations Reducible to Exact Equations, Orthogonal Trajectories, Newton's Law of Cooling, Rate of Decay of Radio-Active Materials.

Linear Differential Equations of Higher Order: Definitions, Operator D, Rules for Finding the Complimentary Function, Inverse Operator, Rules for finding Particular Integral, Working Procedure to Solve the Equation.

UNIT –III **[Text Book-1]**

Linear Dependence of Solutions, Method of Variation of Parameters, Equations reducible to Linear Equations With Constant Coefficients: Cauchy's Homogeneous Linear Equation, Legendre's Linear equation, Simultaneous linear differential equations with constant coefficients.

	Partial Differentiation: Total Derivative, Change of Variables, Jacobians. **Partial Differential Equations**: Introduction, Formation of Partial Differential Equations, Solutions of a Partial Differential Equations, Equations Solvable by Direct Integration, Linear Equations of First Order. **UNIT IV** **[Text Book - 1]** **Laplace Transforms:** Introduction, Definition, Conditions for Existence, Transforms of Elementary Functions, Properties of Laplace Transforms, Transforms of Periodic Functions, Transforms of Derivatives, Transforms of Integrals, Multiplication by t^n, Division by 't', Evaluation of Integrals by Laplace Transforms, Inverse Transforms, Method of Partial Fractions, Other Methods of Finding Inverse, Convolution Theorem, Application to Differential Equations, Unit Step and Unit Impulse Functions.
Text books and Reference books	**Text Book(s):** [1] B.S.Grewal, "Higher Engineering Mathematics", 42nd edition Khanna **Reference Books:** [1] Kreyszig, "Advanced Engineering Mathematics", 8th edition, John Wiley & Sons. [2] Peter V.O.Neil, "Advanced Engineering Mathematics", Thomson, Canada. [3] R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", 3rd edition Narosa Publishers. [4] N.P.Bali, Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications (P) Limited. [5] B.V.Ramana, "A text book of mathematics", Tata MC Graw Hill.
E-resources and other digital material	[1] mathworld.wolfram.com [2] http://www.nptel.iitm.ac.in

14CH1102 - ENGINEEERING CHEMISTRY

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3- 1 - 0
Prerequisites:	Engineering Chemistry(14CH1102)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Analyze various water treatment methods and boiler troubles
	CO2	Apply the knowledge of different phases in materials, working principle of electrodes and batteries and their application in chemical and other engineering areas.
	CO3	Evaluate corrosion processes as well as protection methods and apply the principles of UV-visible spectroscopy in chemical analysis.
	CO4	Apply the knowledge of nature of polymeric materials for their application in technological fields and of fuels for their conservation.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1		H										
	CO2	M											
	CO3											H	
	CO4			M									

Course Content

UNIT-I **[Text Book-1]**

Water technology-I:

Sources and impurities of water, WHO standards - Water treatment for drinking purpose - sedimentation, coagulation, filtration, various methods of disinfection and concept of break-point chlorination - Desalination of brakish water - principle and process of electrodialysis and reverse osmosis.

Water technology-II:

Boiler troubles - scales, sludges, caustic embrittlement and boiler corrosion – causes, disadvantages and prevention, Internal conditioning methods – phosphate, calgon and sodium aluminate – External treatment methods – zeolite and ion-exchange methods.

UNIT-II **[Text Book-1]**

Phase rule:

Concept of phase, component, degree of freedom, Gibb's phase rule definition - phase equilibrium of one component – water system - phase equilibrium of two-component system – sodium chloride-water system and silver-lead system – advantages, limitations and application of phase rule.

Electrochemistry:

	Calomel electrode, silver-silver chloride electrode and glass electrode, determination of pH using glass electrode - Electrochemical energy systems - Zinc-air battery, Lead-acid battery, Ni-Cd battery, $Li_xC/LiCoO_2$ battery – Advantages of lithium batteries. **UNIT-III** **[Text Book-1]** **Corrosion science:** Introduction – chemical and electrochemical corrosion – electrochemical theory of corrosion – corrosion due to dissimilar metals, galvanic series – differential aeration corrosion – cathodic protection, anodic protection, corrosion inhibitors – types and mechanism of inhibition – principle and process of electroplating and electroless plating. **Instrumental techniques of analysis:** Introduction of spectroscopy – interaction of electromagnetic radiation with matter - UV-visible spectroscopy: Frank-Condon principle – types of electronic transitions. Lambert-Beer's law, numericals (simple substitution) – Instrumentation - single beam UV-visible spectrophotometer - applications-qualitative analysis, quantitative analysis, detection of impurities and determination of molecular weight. **UNIT-IV** **[Text Book-1]** **Polymer technology:** Polymerization – Addition and condensation, thermoplastics and thermosettings - conducting polymers – examples, classification-intrinsically conducting polymers and extrinsically conducting polymers- mechanism of conduction of undoped, p-doped and n-doped polyacetylenes – applications of conducting polymers, Fibre reinforced plastics (FRP) - composition and applications. **Fuel technology:** Fuels – classification, calorific value, coal – proximate analysis and ultimate analysis, Petroleum – refining, concept of knocking, octane number and cetane number, flue gas analysis by Orsat's apparatus and numericals based on combustion.
Text books and Reference books	**Text Book(s):** [1] *P.C. Jain*, Engineering Chemistry, 15th edition, DhanpatRai Publishing Company (P) Limited, New Delhi. **Reference Books:** [1] *S.S. Dara*, A text book of Engineering Chemistry, 10th edition, S. Chand & Company Limited, New Delhi. [2] *ShashiChawla*, A text book of Engineering Chemistry, DhanpatRai& Company Pvt. Ltd., New Delhi. [3] *Sunita Rattan*, A Textbook of Engineering Chemistry, First edition, S.K. Kataria& Sons, New Delhi,2012. [4] *B.S. Bahl, G. D. Tuli and ArunBahl*, Essentials of Physical Chemistry, S. Chand and Company Limited, New Delhi. [5] *Y.Anjaneyulu,* Text book of Analytical Chemistry, *K. Chandrasekhar and ValliManickam*, Pharma Book Syndicate, Hyderabad. [6] *O. G. Palanna*, Engineering Chemistry, Tata McGraw Hill Education Pvt. Ltd., New Delhi.

E-resources and other digital material	[1] http://www.cip.ukcentre.com/steam.htm [2] http://corrosion-doctors.org/Modi;es/mod-basics.htm [3] http://chemwiki.ucdavis.edu/Analytical_Chemistry.htm [4] http://teaching.shu.ac.uk/hwb/chemistry/tutorials/molspec/uvvisabl.htm [5] http://www.prenhall.com/settle/chapters/ch15.pdf

14CS1103- INTRODUCTION TO COMPUTING

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0 - 0
Prerequisites:	…	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Understand the changes in hardware and software components.
	CO2	Understand the concept of operating system and its functionalities.
	CO3	Understand types of networks and most common ways of transmitting data via networks and internet.
	CO4	Identify the ways in which a program can work towards a solution by using some processes and tools.
		Develop algorithms and prepare flow charts to simple mathematics and logical problems

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	L	M										
	CO2	M											
	CO3	M	L										
	CO4		L										

Course Content

UNIT-I **[Text Book-1]**

Exploring Computers and their uses Overview: Computers in our world, The computer defined, Computers for individual users, Computers for organizations, Computers in society, Why are computers so important.

Looking inside the computer system Overview: Detecting the ultimate ma- chine, The parts of a computer system, The information processing cycle, Essential computer hardware: processing devices, memory devices, Storage devices, System software, Application software, Computer data, Computer users.

Input and Output devices Overview: Input devices and output devices, various types of input/output devices.

	UNIT–II **[Text Book-1]** **Transforming data into information:** Overview, The difference between data and information, How computers represent data, How computers process data, Machine cycles, Memory, Factors effecting processing speed, The computer's internal clock, The Bus, Cache memory. **Types of storage devices:** Overview, An ever-growing need, Categorizing storage devices, Magnetic storage devices-How data is stored on a disk, How data is organized on a magnetic disk, How the operating system finds data on a disk, Diskettes, hard disks, Removable high-capacity magnetic disks, Tape drives, Optical storage devices, Solid-state storage devices, Smart cards, Solid-state disks. Operating systems basics: Overview, The purpose of operating systems, Types of operating systems, Providing a user interface. **Networking Basics**: Overview, Sharing data anywhere, anytime, The uses of a network, Common types of networks, Hybrid networks, How networks are structured, Network topologies and protocols, Network media, Network hardware. **UNIT–III** **[Text Book-1]** **Data Communications**: Overview, The local and global reach of networks, Data communications with standard telephone lines and modems, Modems, uses for a modem, Using digital data connections, Broad band connections, Wireless net- works. **Productivity Software**: Overview: Software to accomplish the work of life, Acquiring software, Commercial software, Freeware and public domain software, Open-source software, Word processing programs, Spreadsheet programs, Presentation programs, Presenting information managers. **Database management Systems**: Overview, The mother of all computer applications, Databases and Database Management Systems, Flat-File and Relational Database Structure, DBMS, Working with a database. **UNIT–IV** **[Text Book-2]** **Programming languages and the programming process**: Overview, The keys to successful programming, The evolution of programming languages, World wide web development languages, The Systems development life cycle for programming. Creating **Computer programs**: Overview: What is a computer program, Hard- ware/Software interaction, Code, machine code, programming languages, Compilers and interpreters, planning a computer program, How programs solve problems, Purpose of flowcharts and algorithms, flow chart symbols, drawing flow charts, developing algorithms.
Text books and Reference books	**Text Book(s):** [1] Peter Norton, Introduction to Computers, sixth Edition, Tata McGraw Hill [2] Computer Fundamentals and C Programming by ReemaThareja.
E-resources and other digital material	[1] Lecture Series on Computer Organization by Prof.S. Raman, Department of Computer Science and Engineering, IIT Madras https://www.youtube.com/watch?v=leWKvuZVUE8 [2] Lecture Series on Data Communication by Prof.A. Pal, Department of Computer Science Engineering, IIT Kharagpur. [3] https://www.youtube.com/watch?v=sG6WGvzmVaw

14CE1104 - BASICS OF CIVIL ENGINEERING

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0 - 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Attain basic knowledge on civil engineering materials and civil engineering structures.											
	CO2	Attain basic knowledge on sub-structure and super structure of a building.											
	CO3	Attain basic knowledge on principles of surveying, various types of surveying and various types of transportation systems.											
	CO4	Attain basic knowledge on water supply, sewage.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H											
	CO2	H											
	CO3	H											
	CO4	H											

Course Content

UNIT I **[Text Book-1]**

Building Materials:

Introduction - Civil Engineering - Materials: Bricks - composition - classifications - properties -uses. Stone - classification of rocks - quarrying - dressing - properties -uses. Timber - properties -uses -ply wood. Cement - grades -types - properties -uses. Steel - types - mild steel - medium steel - hard steel - properties - uses - market forms. Concrete - grade designation - properties - uses.

UNIT II **[Text Book-1]**

Building Components:

Building - selection of site - classification - components. Foundations -functions -

	classifications - bearing capacity. Flooring - requirements - selection - types - cement concrete marble - terrazzo floorings. Roof - types and requirements. **UNIT III** **[Text Book-1]** **Surveying And Transportation:** Surveying - objectives - classification - principles of survey. Transportation - classification - cross section and components of road - classification of roads. Railway - cross section and components of permanent way -functions. Water way - docks and harbor - classifications - components. Bridge - components of bridge. **UNIT – IV** **[Text Book-1]** **Water Supply And Sewage Disposal:** Dams - purpose - selection of site - types -gravity dam (cross section only). Water supply - objective - quantity of water - sources - standards of drinking water - distribution system. Sewage - classification - technical terms - septic tank - components and functions.
Text books and Reference books	**Text Book(s):** [1] Raju .K.V.B, Ravichandran .P.T, "Basics of Civil Engineering", Ayyappa Publications, Chennai, 2012. [2] Rangwala .S.C, "Engineering Materials", Charotar Publishing House, Anand, 2012. [3] M.S.Palanichamy, "Basic Civil Engineering", Tata McGraw-Hill Publishing Company limited. **Reference Books:** [1] Dr. K.N. Duggal, "Elements of Environmental Engineering", S. Chand and company LTD. Ram Nagar, New Delhi. [2] R.Srinivaas, "Elements of Environmental Engineering", Chartor Publishing House, Arand, 2012
E-resources and other digital material	[1] ncees.org/exmas/fe-exma/ [2] www.aboutcivil.com/

14HS1105 - PROFESSIONAL ETHICS

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0 - 0
Prerequisites:	Knowledge about Morals and Values	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Known the Moral autonomy and uses of Ethical theories.
	CO2	Understand Morals Honesty and Character.
	CO3	Understand about Safety, Risk and Professional Rights.
	CO4	Known the Ethics regarding Global issues like Environment, Computer and

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)(L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M											
	CO2						H						
	CO3					M							
	CO4								H				

Course Content

UNIT- I **[Text Book-1,2]**

Engineering Ethics :

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion- uses of ethical theories**.**

UNIT - II **[Text Book-1,2]**

Human Values :

Morals, Values and Ethics – Integrity– Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment –Empathy – Self-Confidence – Character – Spirituality

UNIT- III **[Text Book-1,2]**

Engineering as Social Experimentation:

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

	Safety, Responsibilities and Rights: Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination **UNIT –IV** **[Text Book-1,2]** **Global Issues**: Multinational corporations- Environmental ethics- computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - moral leadership-sample code of Ethics (Specific to a particular Engineering Discipline).
Text books or Reference books	**Text Book(s):** [1] Mike Martin and Roland Schinzinger. (1996), "Ethics in engineering", McGraw Hill, New York. [2] Govindarajan M, Natarajan S, Senthil Kumar V. S. (2004), "Engineering Ethics", Prentice Hall of India, New Delhi, **Reference Books:** [1] Baum, R.J. and Flores, A., eds. (1978), "Ethical Problems in Engineering, Center for the studyof the Human Dimensions ofScience and Technology", Rensellae Polytechnic Institute,Troy, New York, 335 pp. [2] Beabout, G.R., Wennemann, D.J. (1994), "Applied Professional Ethics: A DevelopmentalApproach for Use with Case Studies", University Press of America Lanham, MD, 175 pp
E-resources and other digital material	[1] http://www.professionalethics.ca/ [2] http://ethics.tamu.edu/ [3] http://en.wikipedia.org/wiki/Professional_ethic

14ME1106 - BASICS OF MECHANICAL ENGINEERING

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0 - 0
Prerequisites:	Knowledge of Mathematics, Physics, Chemistry at Intermediate Level	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Understand the basic manufacturing methods and power transmission in mechanical engineering
	CO1	Attain basic knowledge of simple stress and strain
	CO2	Realize the importance of energy and identify various sources of energy
	CO3	Understand the principle of operation of different I.C. engines and their applications
	CO4	Describe the performance of different types of refrigeration systems
	CO5	Understand the basic manufacturing methods and power transmission in mechanical engineering

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H			M			H					
	CO2	H			M	H							
	CO3	H			H								
	CO4	H			H			H					

Course Content

UNIT- I **[Text Book-1,2]**

Manufacturing Methods :

Casting*:* Principles of Casting, Advantages & disadvantages, Applications of casting, Green sand moulds

Lathe *:* Description, Main components , Basic operations performed on a Lathe (Turning, Taper turning, Thread cutting, Drilling)

Welding : Types : Equipments, Principles of Gas Welding and Arc Welding, Applications, Advantages & disadvantages of welding, Brazing & Soldering

UNIT- II **[Text Book-1,3]**

Simple Stress and Strain:

Stress and Strain, definitions, Elasticity, Hooke's Law, Relation between elastic constant

Transmission:

Belt Drives Introduction, Types, Length of Open Belt drive and cross belt drive, Velocity ratio and difference between open belt drive & Cross belt drive, Poweer transmission by belts

Text books and Reference books	**UNIT- III** **[Text Book-2]** **Energy Resources:** Introduction, Energy Scenario, Classification of Energy Resources, Conventional Energy Resources : working principle of Steam power plant, Nuclear Power plant Non-conventional Energy Resources : Working principle of Solar Power plant, Wind power plant, Geo-Thermal and OTEC plant **UNIT IV** **[Text Book-1,2]** **Internal Combustion Engines:** Introduction, Classification, Main components of an I.C. engine, Working principle of Two Stroke and Four Stroke Petrol and Diesel engine **Refrigeration**: Introduction, Classification, Types of Refrigeration, Units of Refrigeration, C.O.P., working of vapour compression refrigeration system, applications of refrigeration
Text Books and Reference Books	**Text Book(s):** [1] Basic Mechanical Engineering by T.S. RAJAN 3rd Edition, New Age International Ltd,First Reprint 1999. [2] Machine Design by R.S. KHURMI & J.K. GUPTA, Eurasia Publications House 2005. [3] Basic Mechanical Engineering by T.J. PRABHU & V. Jaiganesh, S.Jebaraj SCI Tech Publications (India) Pvt. Ltd. **Reference Books:** [1] Thermal Engineering by R. Rudramoorthy, 4th Reprint 2006 Tata Mc-Graw Hill Publishing Company Ltd, New Delhi (2003). [2] Manufacturing Process by R.K. Rajput , Firewall media (2007). [3] Power Plant Engineering by P.K. Nag Tata McGraw Hill Publishing Company Ltd, New Delhi (2011).
E-Resources and other digital material	[1] www.engliblogger.com/mechanical/mechan [2] www.indiastudychannel.com/resources [3] www.result.khatana.net/2010/07/ge2152 [4] www.scribd.com/doc/15653381/basic-mech

14ME1107 – MECHANICS FOR ENGINEERS

Course Category:	Institutional Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4- 1 - 0
Prerequisites:		**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Construct free body diagrams and develop appropriate equilibrium equations.
	CO2	Locate centroids and simplify the system of forces and moments to equivalent systems.
	CO3	Analyze systems with friction.
	CO4	Determine the kinematic relations of particles.
	CO5	Apply equations of motions to particle motion.
	CO6	Analyze motion of particles using the principle of energy and momentum methods.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1		L										
	CO2	L											
	CO3		L										
	CO4		H										
	CO5	L											
	CO6		L										

Course Content

UNIT-I

Concurrent Forces in a Plane :

Principles of statistics, Force, Addition of two forces: Parallelogram Law – Composition of resolution of forces – Constraints, Action and reaction. Types of Supports and support reactions, Free body Diagram, Equilibrium of concurrent forces in a plane – Method of Projections – Moment of a force, Theorem of Varignon, Method of moments.

Parallel Forces in a Plane :

Introduction, Types of parallel forces, Resultant, Couple, Resolution of force into force and a couple, General case of parallel forces in a plane.

Centroids :

Determination of Centroids by integration method, Centroids of Composite plane figures.

UNIT-II

General Case of Forces in a Plane :

Composition of Forces in a Plane – Equilibrium of Forces in a plane.

Friction :

Introduction, Classification of friction, Laws of dry friction, Coefficient of

	friction, Angle of friction, Angle of response, Cone of friction, Wedge friction. **Kinematics of Rectilinear Translation :** Introduction, displacement, velocity and acceleration, Motion with Uniform acceleration. **UNIT-III** **Kinematics of Rectilinear Translation :** Equations of rectilinear motion, Equations of Dynamic equilibrium: D'Alembert's Principle, Work and Energy Principle, Conservation of Energy Principle, Impulse and momentum principle, Impact-Direct central Impact. **UNIT-IV** **Kinematics of Curvilinear Motion:** Introduction, Rectangular components of velocity and acceleration, Normal and Tangential acceleration, Motion of projectiles. **Kinematics of Curvilinear Translation:** D'Alembert's Principle in curvilinear motion:Rectangular components, Normal & tangential components, Work and Energy Principle.
Textbooks and Reference books	**Text Book(s):** [1] A.K.Tayal "Engineering Mechanics Statics and dynamics", XIII$^{the\ d}$, Umesh Publication, 2006. (For numerical Problems using S.I. System of Units). [2] S.Timoshenko, D.H. Young, J.V. Rao & Sukumar Pati, "Engineering Mechanics" Vth ed, Mc Graw Hill Education (India) Pvt LTD,2013. (For Concepts and symbolic Problems using S.I System of Units). **Reference Books:** [1] Beer & Johnston, "Vector Mechanics for Engineers Statics and Dynamics" IIIrd ed, Tata McGraw Hill Publishing Company, 2010. [2] SS Bhavikatti & KG Rajasekharappa, "Engineering Mechanics" IV$^{the\ d}$, New Age International Private Limited,2012. [3] K.Vijaya Kumar Reddy and J Suresh Kumar, " Singer's Engineering Mechanics Statics and Dynamics " IIIrd ed, BS Publications, 2010. [4] Andrew pytel & Jaan Kiwsalaas , " Engineering Mechanics: Statics and Dynamics" IIIrd edition, Cengage Learning, 2013.
E-resources and other digital material	[1] http://openlibrary.org/books/OL22136590M/Basic engineering mechanics [2] http://en.wikibooks.org/wiki/Engineering Mechanics [3] http://nptel.iitm.ac.in/vedio.php?courseId=1048 [4] http://imechanica.org/node/1551 [5] http://emweb.unl.edu [6] http://ebooks-freedownload.com/2009/11/engineering-mechanics-statics-12.html [7] http://www.ebookee.com/Engineering-Mechanics-Statics37859.html

14CH1151- ENGINEEERING CHEMISTRY LAB

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Practice	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:	Knowledge of Chemistry Practical at Intermediate level	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Analyze quality parameters of water samples from different sources.
	CO2	Perform quantitative analysis using instrumental methods.
	CO3	Apply the knowledge of mechanism of corrosion inhibition, metallic coatings and photochemical reactions.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1		H										
	CO2											M	
	CO3					M							

Course Content

List of Experiments:

1. Determination of total alkalinity of water sample
2. Determination of chlorides in water sample
3. Determination of hardness of water sample
4. Determination of available chlorine in bleaching powder
5. Determination of copper in a given sample
6. Estimation of Mohr's salt – Dichrometry
7. Estimation of Mohr's salt – Permanganometry
8. Determination of zinc in a given sample
9. Conductometric determination of a strong acid using a strong base
10. pH metric titration of a strong acid vs. a strong base
11. Determination of corrosion rate of mild steel in the absence and presence of an inhibitor
12. Chemistry of Blue Printing

	13. Colorimetric determination of potassium permanganate 14. Preparation of Phenol-Formaldehyde resin 15. Spectrophotometry
Text books and Reference books	**Text Book(s):** [1] *S.K. Bhasin and Sudha Rani*, Laboratory Manual on Engineering Chemistry, 2nd edition, DhanpatRai Publishing Company, New Delhi. [2] *Sunitha Rattan*, Experiments in Applied Chemistry, 2nd edition, S.K. Kataria& Sons, New Delhi.
E-Resources and other digital material	

14CS1152- BASIC COMPUTING LAB

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Practice	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Understand the changes in hardware and software components.
	CO2	Understand the concept of operating system and its functionalities.
	CO3	Understand types of networks and most common ways of transmitting data via networks and internet.
	CO4	Identify the ways in which a program can work towards a solution by using some processes and tools.
	CO5	Develop algorithms and prepare flow charts to simple mathematics and logical problems

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	L	M										
	CO2	M											
	CO3	M	L										
	CO4		L										
	CO5	M	M										

Course Content

CYCLE - I

Word Processing, Presentations and Spread Sheets:

1. *Word Processing:*
   a) Create personal letter using MS Word.
   b) Create a resume using MS Word.
2. *Spread Sheets:*
   a) Create a worksheet containing pay details of the employees.
   b) Create a worksheet which contains student results.
   c) Create a worksheet importing data from database and calculate sum of all the columns.
3. *Presentations:*
   a) Create a presentation using themes.
   b) Save, edit, print and import images/videos to a presentation.
   c) Adding animation to a presentation.
4. *MS Access:*
   a) Create simple table in MS Access for results processing.

	b) Create a query table for the results processing table. c) Create a form to update/modify the results processing table. d) Create a report to print the result sheet and marks card for the result. ***CYCLE - II*** **Hardware Experiments:** 1. Identification of System Layout: Front panel indicators & switches and Front side & rear side connectors. Familiarize the computer system Layout: Marking positions of SMPS, Motherboard, FDD, HDD, CD, DVD and add on cards. Install Hard Disk. Configure CMOS-Setup. Partition and Format Hard Disk. 2. Install and Configure a DVD Writer or a Blu-ray Disc writer. 3. Install windows operating system and check if all the device (graphics, sound, network etc.) drivers are installed. 4. Install Linux operating system and check the working of all devices (graphics, sound, network etc.) in the computer. 5. Assemble a Pentium IV or Pentium Dual Core Pentium Core2 Duo system with necessary peripherals and check the working condition of the PC. 6. PC system layout: Draw a Computer system layout and Mark the positions of SMPS, Mother Board, FDD, HDD, and CD-Drive/DVD- Drive add on cards in table top / tower model systems. 7. Mother Board Layout: Draw the layout of Pentium IV or Pentium Dual core or Pentium Core2 DUO mother board and mark Processor, Chip set ICs. RAM, Cache, cooling fan, I/O slots and I/O ports and various jumper settings.
E-Resources and other digital material	[1] Numerical Methods and Programing by Prof.P.B.Sunil Kumar, Department of Physics, IIT Madras https://www.youtube.com/watch?v=zjyR9e-N1D4&list=PLC5DC6AD60D798FB7 [2] Introduction to Coding Concepts Instructor: Mitchell Peabody View the complete course: http://ocw.mit.edu/6-00SCS11

14ME1153 - WORKSHOP PRACTICE

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Practice	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	To model and develop various basic prototypes in the Carpentry trade such as Lap Joint, Lap Tee Joint, Dove Tail Joint, Mortise and Tenon Joint, and Cross Lap Joint.
	CO2	To develop various basic prototypes in the trade of Welding such as Lap Joint, Lap Tee Joint, Edge Joint, Butt Joint and Corner Joint
	CO3	To develop various basic prototypes in the trade of Tin Smithy such as Saw Edge, Wired Edge, Lap Seam, Grooved Seam and Funnel Preparations
	CO4	To understand various basic House Wiring techniques such as Connecting One lamp with one switch, Connecting two lamps with one switch, Connecting a Fluorescent tube, Staircase Wiring, Godown Wiring .

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H									L	
CO2	M	H									L	
CO3	M	H									L	
CO4	L	H									L	

Course Content

UNIT I

Carpentry : To Make the following Jobs with Hand Tools:

a. Lap Joint.
b. Lap Tee Joint.
c. Dove Tail Joint.
d. Mortise and Tenon Joint.
e. Cross Lap Joint.

UNIT II

Welding: To Make the following Jobs using Electric Arc Welding Process / Gas Welding.

a. Lap Joint.
b. Tee Joint.
c. Edge Joint.
d. Butt Joint.
e. Corner Joint.

	UNIT III **Tin Smithy:** To do Sheet Metal Operations with Hand Tools: a. Saw Edge. b. Wired Edge. c. Lap Seam. d. Grooved Seam. e. Funnel. **UNIT IV** **House Wiring:** a. To connect one lamp with one switch. b. To connect two lamps with one switch. c. To connect a fluorescent Tube. d. Stair case wiring. e. Godown Wiring.
Text books and Reference books	**Text Book(s):** [1] Kannaiah P. &Narayana K. C., "Manual on Workshop Practice", Scitech Publications, Chennai, 1999.

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14MA1201 - CALCULUS

Course Category:	Institutional Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 1 - 0
Prerequisites:	Fundamentals of calculus, vectors and geometry.	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Understand the concept of mean value theorems and apply them to expand functions as Taylors series and determine curvatures.											
	CO2	Able to test the convergence of infinite series, tracing of the curves.											
	CO3	Understand the concept of multiple integrals and apply them to evaluate areas and volumes.											
	CO4	Apply the concepts of calculus to scalar and vector fields and establish the relation between the line ,surface and volume integrals.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	L			M		L				M	
	CO2	H	L			M		L				M	
	CO3	H	M			M		L				M	
	CO4	H	M			M		L				H	

Course Content

UNIT–I **[Text Book-1]**

Differential Calculus:

Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem, Taylors Theorem, Maclaurin's Series, Taylor's Theorem for Function of Two Variables, Curvature, Radius of Curvature.

UNIT–II **[Text Book-1]**

Asymptotes, Curve Tracing, Maxima and Minima of Function of Two Variables, Lagrange's Method of undetermined Multipliers.

Sequence and Series:

Convergence of series – Comparison test – D'Alembert's Ratio test – Cauchy's Root Test – Alternating series – Absolute convergence – Leibnitz's Rule.

UNIT–III **[Text Book-1]**

Integral Calculus:

Double Integrals, Change of Order of Integration, Double Integrals in Polar Coordinates, Area Enclosed by Plane Curves, Triple Integrals, Volumes of Solids, Change of Variables.

Special Functions:

Beta Function, Gamma Function, Relation between Beta and Gamma Function, Error

	Function or Probability Integral. **UNIT–IV** **[Text Book-1]** **Vector Calculus**: Scalar and Vector Point Functions, Del Applied to Scalar point Functions, Gradient, Del Applied to Vector point Functions, Physical Interpretation of Divergence, Del Applied Twice to Point Functions, Del Applied to Products of Point Functions, Integration of Vectors, Line Integral, Surface Integrals, Green's Theorem in The Plane (without Proof), Stokes's Theorem (without proof), Volume Integral, Gauss Divergence Theorem (without proof), Irrotational Fields.
Text books and Reference books	**Text Book(s):** [1] B.S.Grewal, "Higher Engineering Mathematics", 42nd edition Khanna Publishers, 2012. **References Books:** [1] Kreyszig, "Advanced Engineering Mathematics ", 8th edition, John Wiley & Sons. [2] Peter V.O.Neil, "Advanced Engineering Mathematics ", Thomson, Canada. [3] R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics ", 3rd edition Narosa Publishers. [4] N.P.Bali, Manish Goyal, "A Text Book of Engineering Mathematics", LaxmiPublications(P) Limited. [5] B.V.Ramana, " A text book of mathematics ", Tata MC Graw Hill
E-resources and other digital material	[1] mathworld.wolfram.com [2] http://www.nptel.iitm.ac.in

14PH1202 - ENGINEERING PHYSICS

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Programming in C (14CS1203)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand the differences between classical and quantum mechanics and learn about statistical mechanics											
	CO2	Understand various properties and applications of magnetic & dielectric materials and the theory of super conductivity											
	CO3	Analyze and understand semiconductor technology and various types of lasers & optical fibers.											
	CO4	Understand the fabrication of nano-materials, carbon nano-tubes and their applications in various fields											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H				M			M	L			L
	CO2	H	M	L		M				M			H
	CO3	H	M	M						M			H
	CO4	H		L		M				M	L		H

Course Content

UNIT I **[Text Book-1,2]**

Quantum Mechanics:

Dual nature of light, Matter waves and Debroglie's hypothesis, G.P. Thomson experiment, Heisenberg's uncertainty principle and its applications (Non-existence of electron in nucleus, Finite width of spectral lines),Classical and quantum aspects of particle, One dimensional time independent Schr¨odinger's wave equation, physical significance of wave function, Particle in a box (One dimension).

Statistical Mechanics:

Phase space, Differences between Maxwell-Boltzmann,
Bose-Einstein and Fermi-Dirac statistics (qualitative), Fermi-Dirac probability function, Fermi energy level.

UNIT II **[Text Book-2]**

Magnetic properties:

Magnetic permeability, Magnetization, Origin of magnetic moment, Classification of magnetic materials -dia, para, ferro magnetic materials, Hysteresis curve.

Dielectric properties:

Fundamental definitions: Dielectric constant, Electric polarization, Polarizability,

	Polarization vector, Electric displacement, Electric susceptibility, Types of Polarization: Electronic, Ionic, Orientation, Space charge polarization, Internal fields in solids (Lorentz method), Clausius-Mossotti equations, Frequency dependence of polarization, Ferroelectrics and their applications. **Superconductivity:** Introduction, Critical parameters, Flux quantization, Meissner effect, Types of Superconductors, BCS theory, Cooper pairs, London's equation penetration depth, high temperature super conductors, Applications of superconductors. **UNIT III** **[Text Book-1,2]** **Semiconductor Physics:** Classification of materials based on energy diagram, Fermi level in Intrinsic and extrinsic semiconductors ,Carrier drift and Carrier diffusion, Generation and recombination process (qualitative), Hall Effect. **Lasers:** Spontaneous emission, Stimulated emission, Population inversion, Solid state (Ruby) laser, Gas (He-Ne) laser, Semiconductor (Ga-As) laser, Applications of lasers. **Fiber optics:** Propagation of light through optical fiber, Types of optical fibers, Numerical aperture, Fiber optics in communication and its advantages. **UNIT IV** **[Text Book-1]** **Nanotechnology:** Basic concepts of Nanotechnology, Nano scale, Introduction to Nano-materials, Surface to volume ratio, General properties of Nano materials, Fabrication of Nano-materials: Plasma Arcing, Sol-gel, Chemical vapour deposition, **Characterization of nano materials:** AFM, SEM, TEM, STM, MRFM, Carbon nano tubes: SWNT, MWNT, Formation of carbon nano tubes: Arc discharge, Laser ablation, Properties of carbon nano tubes, Applications of CNT's& Nanotechnology.
Textbooks and Reference books	**Text Book(s):** [1] M.N. Avadhanulu& P.G. Kshirsagar,"A text of Engineering Physics", S.Chand publications. [2] P.K. Palanisamy,"Applied Physics",Scitech Publishers. **Reference Books:** [1] R.K.Gaur and S.L.Gupta, "Engineering Physics",Dhanpatrai publishers. [2] S.O. Pillai, "Solid State Physics", New age international publishers. [3] M.R. Srinivasan, "Engineering Physics"New age international publishers. [4] M.Armugam, "Engineering Physics",Anuradha publishers.
E-resources and other digital material	[1] http://www.light and matter.com/bk4.pdf [2] http://www.ifw-resden.de/institutes/itf/members/helmut/sc1.pdf [3] http://www.microscopy.ethz.ch/history.htm [4] http://nptel.ac.in/courses.php?disciplineId=115 [5] http://aph.huji.ac.il/courses/2008 9/83887/index.html http://freevideolectures.com/Course/3048/Physics-of-Materials/36

14CS1203 - PROGRAMMING IN C

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:		**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the programming terminology and implement various- tokens & input-output statements to solve simple problems.
	CO2	Compare various looping & branching constructs and apply the best looping structure for a given problem.
	CO3	Implement arrays and structure/union for storing homogeneous and heterogeneous groups of data.
	CO4	Implement programs using pointers to directly ascending memory locations & file operations.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2		M										
CO3		M										
CO4	L	M										

Course Content

UNIT I **[Text Book-1]**

Structure of a C Program:

Expressions, Precedence and Associatively, Evaluating Expressions, Type Conversion, Statements, Sample Programs. Selection: Logical Data and Operators, Two-Way Selection, Multiway Selection, More Standard Functions.

UNIT II **[Text Book-1]**

Repetition:

Concept of a Loop, Loops in C, Loop Examples, Recursion, The Calculator Program.

Arrays:

Concepts, Using Array in C, Inter-Function Communication, Array Applications, Two Dimensional Arrays, Multidimensional Arrays. Functions: Functions in C, User Defined Functions, Inter Function Communication, Standard Functions, and Scope.

Strings:

String Concepts, C Strings, String Input/Output Functions, Arrays of Strings, String

	Manipulation Functions, String-Data Conversion. **UNIT III** **[Text Book-1]** **Pointers:** Introduction, Pointers For Inter Function Communications, Pointers to Pointers, Compatibility, L value and R vlaue. Pointer Applications: Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocations Functions, Array Of Pointers. **Text Input/Output:** Files, Streams, Standard Library Input/Output Functions, Formatting Input/Output Functions and Character Input/Output Functions. **UNIT IV** **[Text Book-1]** **Enumerations:** The Type Definition (Typedef), Enumerated Types: Declaringan Enumerated Type, Operationson Enumerated Types, Enumeration Type Conversion, Initializing Enumerated Constants, Anonymous Enumeration: Constants, Input/Output Operators. **Structures:** Structure Type Declaration, Initialization, Accessing Structures, Operationson Structures, Complex Structures, Structures and Functions, Sending the Whole Structure, Passing Structures Through Pointers. **Unions:** Referencing Unions, Initializers, Unions and Structures, Internet Address, Programming Applications.
Textbooks and Reference books	**Text Book(s):** [1] Behrouz A.Forouzan & Richard F.Gilberg, Computer Science a Structured Programming Approach using C, Third Edition, CEN- GAGE Learning. **Reference Books:** [1] Balagurusamy, ProgramminginANSIC4ed.:TMH,2009 [2] B.Gottfried, Programming with C (Schaum's Outlines) Tata Mc graw- Hill. [3] Kernighan and Ritchie, The C programming language: Prentice Hall. [4] Venugopal, et.al. Programming with C:TMH. [5] A.S.Tanenbaum, Y.Langsam, and M.J.Augenstein, Data Structures Using C, PHI/Pearson education.
E-resources and other digital material	**--**

14HS 1204 – TECHNICAL ENGLISH &COMMUNICATION SKILLS

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0 - 2
Prerequisites:	Basic understanding of the language skills ,viz Listening, Speaking, Reading and Writing, including Sentence construction abilities	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Be proficient in administrative and professional compilation skills including web related communication
	CO2	Attain practice in Interpersonal Communication, in addition to standard patterns of Pronunciation
	CO3	Be aware of the elements of functional English for authentic use of language in any given academic and/or professional environment
	CO4	Enhance Reading skills, along with a wide range of Vocabulary
	CO5	Acquire competence in Technical communication sills

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1			M	M	M	H	H	M	M	H	L	M
	CO2			M	H	L	H	H	H	M	H	L	M
	CO3	M			M		H	H	H	H	H	L	M
	CO4		M	M	M	L	H	H	H	M	H		M
	CO5	L	M	M	H	M	H	H	H	H	H	L	M

Course Content

UNIT - I

Professional Writing Skills:

1. Professional Letter- Business, Complaint, Explanation and Transmittal
2. Essay Writing- - Descriptive, Reflective and Analytical-
3. Administrative drafting and correspondence –Memos, Minutes and Web notes

UNIT – II

Interpersonal Communication Skills:

1. ***Communicative Facet***: Speech acts- Extending Invitation, Reciprocation, Acceptance, Concurrence, Disagreeing without being disagreeable
2. ***Articulation Oriented Facet:*** Phonetic Transcription using IPA symbols with

	Vowel and Consonant charts **UNIT – III** **Vocabulary and Functional English:** 1. A basic List of 500 words – Over view 2. Verbal analogies, Confusables, Idiomatic expressions and Phrasal Collocations 3. Exposure through Reading Comprehension- Skimming, Scanning, Understanding the textual patterns for tackling different kinds of questions and Taming Regression 4. Functional Grammar with special reference to Concord, Prepositions and Pronoun-referent analysis. **UNIT IV** **Technical Communication Skills:** 1. Technical Proposal writing 2. Technical Vocabulary- a representative collection will be handled 3. Developing Abstract 4. Introduction to Executive summary **5.** Technical Report writing(Informational Reports and Feasibility Reports)
Textbooks and Reference books	**Text Book(s):** [1] TM Farhathullah, Communication skills for Technical Students, I Edition Orient Longman, 2002 [2] 'Krishna', English Language Communication Skills, I Edition, Duvvuri Publications, 2008 [3] B.S .Sarma, Structural Patterns & Usage in English, IVEdition, Poosha Series, , 2008 [4] Eclectic Learning materials offered by the Department **Reference Books:** [1] Randolph Quirk, Use of English, Longman, I Edition (1968), Reprinted 2004. [2] Thomson A.J & A.V, Martinet, Practical English Grammar, III Edition, Oxford University Press,2001 [3] Thomas Eliot Berry, The most Common Mistakes in English, TMH, First Paper Back 1971, (reprinted) 2010. [4] John Langan, College Writing Skills, McGraw Hill, IX Edition 2014. [5] Selinkar, Larry et al, English for Academic and Technical Purposes, I edition, Newbury House Publishers, 1981 [6] Martin Cutts, Oxford guide to Plain English, 7th Impression Oxford University Press, 2011 [7] V.Sethi and P.V. Dhamija, A Course in Phonetics and Spoken English, II edition, PHI, 2006.

E-resources and other digital material	*[1] www.**britishcouncil**.org/**learning**-english-gateway.htm up dated 2014* *[2] pdfstuff.blogspot.com/2013/.../the-**oxford**-guide-to-**english**-usage-pdf.ht.* *[3] www.**cambridge**apps.org/ up dated 2014*

14EE1205 - BASICS OF ELECTRICAL ENGINEERING

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0 - 0
Prerequisites:	Engineering Physics (14PH1202)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Analyze electric circuit fundamentals.
	CO2	Understand the basic concepts of Electromagnetism.
	CO3	Analyze the basic concepts of Electric Machines
	CO4	Understand measuring instruments & utilization concepts.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M										
CO2	M	M										
CO3	L											
CO4	L											

Course Content

UNIT I **[Text Book-1]**

DC Circuits:

Definitions of work, power, energy and torque; Ohms law; Kirchhoff's laws; Series-parallel resistive circuits; Star-delta transformation;

AC Circuits:

Generation of sinusoidal signal ; RMS, Average values, Form factor, Peak factor

UNIT II **[Text Book-1]**

Magnetic effect of an electric current; cross and dot conventions; concept of m.m.f., flux, flux density, reluctance, permeability and field strength; Self and Mutual inductances; Fleming's left hand rule; Faradays laws of electromagnetic induction, statically and dynamically induced e.m.f.,

UNIT III **[Text Book-1]**

	D.C. Machines: Classification of dc machines; Principle of motor and generator; back emf; Torque of a dc machine; Load characteristics of shunt, series motors **AC Machines:** Classification of ac machines; Production of rotating field; Constructional features – principle of operation; Torque-slip characteristics. **UNIT IV** **[Text Book-1]** **Measuring Instruments**: Classification of instruments; Principle of operation of moving-coil and moving-iron instruments; – Dynamometer –type watt meter **Utilization:** Principles of resistance and induction heating – principles of electrical traction – speed time characteristics.
Textbooks and Reference books	**Text Book(s):** [1] I.J.Nagrath and Kothari, "Theory and problems of Basic Electrical Engineering", Prentice- Hall of India Pvt. Ltd. **Reference Books:** [1] Dr. K. Uma Rao, Dr. A. Jayalakshmi, "Basic Electric Engineering", Pearson Publications. [2] T.K. Nagasarkar and M.S. Sukhja, "Basic Electric Engineering":, Oxford University press.
E-resources and other digital material	**--**

14EC1206 – BASICS OF ELECTRONICS ENGINEERING

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0 - 0
Prerequisites:		**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Gain knowledge about the fundamentals of electronic components, devices, transducers											
	CO2	Understand and apply principles of digital electronics											
	CO3	Get familiarity about basic communication systems											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	L											
	CO2	M											
	CO3	L											

Course Content

UNIT I **[Text Book-1]**

Electronic Components:

Passive components – resistors, capacitors & inductors (properties, common types, I-V relationship and uses).

Semiconductor Devices:

Semiconductor Devices - Overview of Semiconductors - basic principle, operation and characteristics of PN diode, zener diode, BJT, JFET, optoelectronic devices (LDR, photodiode, phototransistor, solar cell, photo couplers)

UNIT II **[Text Book-1,2,3]**

Transducers:

Transducers - Instrumentation – general aspects, classification of transducers, basic requirements of transducers, passive transducers - strain gauge, thermistor, Hall-Effect transducer, LVDT, and active transducers – piezoelectric and thermocouple.

UNIT III **[Text Book-1,3]**

Digital Electronics:

Number systems – binary codes - logic gates - Boolean algebra, laws & theorems - simplification of Boolean expression - implementation of Boolean expressions using logic

	gates - standard forms of Boolean expression. **UNIT IV** **[Text Book-3]** **Communication Systems:** Block diagram of a basic communication system – frequency spectrum - need for modulation - methods of modulation - principles of AM, FM, pulse analog and pulse digital modulation – AM / FM transmitters & receivers (block diagram description only)
Textbooks and Reference books	**Text Book(s):** [1] Thyagarajan. T, Sendur Chelvi. K. P, Rangaswamy. T. R, "Engineering Basics: Electrical, Electronics and Computer Engineering", New Age International, Third Edition, 2007. [2] Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education, 2013. [3] G.K.Mithal, "Radio Engineering", 20th Edition, Khanna Publishers, , 2011. **Reference Books:** [1] Somanathan Nair. B, Deepa. S. R, "Basic Electronics", I.K. International Pvt. Ltd., 2009. [2] S. Salivahanan, N.Suresh Kumar & A. Vallavaraj, "Electronic Devices & Circuits", 2nd Edition, Tata Mc Graw Hill,2008.
E-resources and other digital material	[1] http://www.nptel.ac.in/courses/Webcourse-contents/IIT-ROORKEE/BASIC-ELECTRONICS/ home_page.htm [2] http://nptel.ac.in/video.php?subjectId=117102059

14ME1251 - ENGINEERING GRAPHICS

Course Category:	Institutional Core	**Credits:**	5
Course Type:	**Practical**	**Lecture - Tutorial - Practice:**	2 - 0 - 6
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Represent various Conics and Curves
	CO2	Construct Plain and Diagonal Scales
	CO3	Draw Orthographic projections of Lines, Planes, and Solids
	CO4	Construct Isometric Scale, Isometric Projections and Views and also convert pictorial views to Orthographic Projections.
	CO5	Draw Sectional views of the Solids
	CO6	Understand Development of surfaces and their representation

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		H				H					
CO2	H		H				H					
CO3	H		H				H					
CO4	H		H				H					
CO5	M		M				M					
CO6	M		M				M					

Course Content

UNIT - I

General:

Use of Drawing instruments, Lettering - Single stroke letters, Dimen- sioning, Representation of various type lines - Geometrical Constructions. Scales: Construction and use of plain and diagonal scales.

Conic Sections:

Conic sections - general construction method for ellipse, parabola and hyperbola. Special methods for conic sections.

Curves:

Curves used in Engineering practice - Cycloid, Involute of circle.

UNIT - II

Method of Projections:

Principles of projection - First angle projection and third angle projection of points and straight lines.

	Projection of Planes: ***Projections of planes of regular geometrical lamina:*** Introduction to Auto CAD software, drawing different two dimensional and three dimensional views. ***2 D Objects :*** Triangles, Square, Rectangle, Pentagon, Hexagon, Circle and Ellipse. **UNIT - III** **Projections of Solids:** Projections of simple solids such as Cubes, Prisms, Pyramids, Cylinders and Cones - axis inclined to one of the reference plane. Sections of Solids: Sections of solids such as Cubes, Prisms, Pyramids, Cylin- ders and Cones. True shapes of sections. (Limited to the Section Planes perpen- dicular to one of the Principal Plane). ***3 D Objects :*** Prisms, Pyramids, Cylinder and a Cone. Sectional view of a Prism, Pyramid, Cylinder and a Cone in simple posi- tions **UNIT - IV** **Development of Surfaces:** Lateral development of cut sections of Cubes, Prisms, Pyramids, Cylinders and Cones. **Isometric Projections:** Isometric Projection and conversion of Orthographic Projections into isometric views. (Treatment is limited to simple objects only). Introduction to Isometric Projections to Orthographic Projections. Isometric View of Prism, Pyramid, Cylinder and a Cone and also simple **3 Dimensional Objects:** * These topics are only for internal assessment.
Text books and Reference books	**Text Book(s):** [1] N.D. Bhatt & V.M. Panchal, "Elementary Engineering Drawing", Charotar Publishing House, Anand. 49th Edition - 2006. [2] DM Kulkarni, AP Rastogi, AK Sarkar, "Engineering Graphics with Auto CAD", PHI Learning Private Limited, Delhi. Edition - 2013 **Reference Books:** [1] Prof. K. L. Narayana & Prof. P. Kannaiah, "Text Book on Engineering Drawing", Scitech publications (India) Pvt. Ltd., Chennai 2nd Edition - fifth reprint 2006. [2] K. Venugopal, "Engineering Drawing and Graphics + Auto CAD", New Age International, New Delhi.
E-resources and other digital material	http://www.youtube.com/watch?v=XCWJXrkWco http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html# ***iso drawing*** http://www.slideshare.net http://edpstuff.blogspot.in

14CS1252- PROGRAMMING IN C LAB

Course Category:	**Programme core**	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 0 – 3
Prerequisites:	--	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the programming terminology and implement various c- tokens & input-output statements to solve simple problems
	CO2	Compare various looping & branching Constructs and apply the best looping structure for a given problem
	CO3	Implement arrays and structure/union for storing Homogeneous and heterogeneous groups of data
	CO4	Implement programs using pointers to directly accenting memory locations & file operations
	CO5	Identify the necessity of modularity in programming and design various function types

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2		M										
CO3		M										
CO4	L	M										
CO5	L	M										

Course Content

CYCLE-I:

Programming constructs and control structures:

1. Introduction to C programming:
   a) Use of Turbo C IDE
   b) The Structure of a C Program
   c) Writing C Programs
   d) Building an Executable Version of a C Program
2. Data Types and Variables:
   a) DataTypes
   b) Operands, Operators
   c) Arithmetic Expressions

	3. Branching and Selection: a) Simple-if b) Nested-if 4. Control statements: a) Break b) Continue c) Goto 5. Looping constructs-I a) While b) Do-while c) Case control structure: Switch 6. Looping constructs-II a) Simple for b) Nested for 7. Arrays a) Single dimensional arrays b) Multi-dimensional arrays 8. Strings a) Declaration and initialization of string variables b) Reading &Writing strings c) String handling functions d) Operations performed on strings without using string handling functions **CYCLE-II** : **Advanced programming constructs:** 1. Concept of user defined functions a) With arguments and no return value b) Without arguments and no return value c) Without arguments and return value d) With arguments and return value 2. File handling operations a) FILE structure b) Opening and closing a file, file open modes c) Reading and writing operations performed on a file d) File Pointers: std in, std out and std err e) FILE handling functions: fgetc(), fputc(), fgets() and fputs() f) Functions 3. Pointers a) Uses of Pointers b) Passing Arrays and Pointers as a function arguments c) Pointers to Character Strings 4. User defined data types a) Type-def b) Enumeration
E-resources and other	*Numerical Methods and Programing by Prof.P.B.Sunil Kumar, Department of Physics, IITMadras* [1] https://www.youtube.com/watch?v=zjyR9e-N1D4& list=PLC5DC6AD60D798FB7

digital material	Introduction to Coding Concepts Instructor: Mitchell Peabody View the complete course: [2] http://ocw.mit.edu/6-00SCS11

14PH1253- ENGINEERING PHYSICS LAB

Course Category:	**Programme core**	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 0 – 3
Prerequisites:	--	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Elucidate the concepts of physics through involvement in the experiment by applying theoretical knowledge											
	CO2	Illustrate the basics of electro magnetism, optics, mechanics, and semi-conductors & quantum theory											
	CO3	Develop an ability to apply the knowledge of physics experiments.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1			H	M								M
	CO2		M			M							
	CO3			H									M
Course Content	1. AC Sonometer -Verification of vibrating laws. 2. Measurement of thickness of a foil using wedge method. 3. Photo tube-Study of V-I Characteristics, determination of work function. 4. Torsional Pendulum-Rigidity modulus calculation. 5. Variation of magnetic field along the axis of a current carrying circular coil. 6. Compound pendulum-Measurement of 'g'. 7. LCR circuit-Resonance. 8. Solar cell -Determination of Fill Factor. 9. Hall effect -Study of B & I Variation. 10. Fibre Optics-Numerical aperture calculation. 11. Newton's Rings-Radius of curvature of plano convex lens. 12. Diffraction grating-Measurement of wavelength.												

	13. Lissajous figures- calibration of an audio oscillator. 14. B-H curves- determination of hysteresis loss. 15. Figure of merit of a galvanometer.
Text books and Reference books	**Text Book(s):** [1] Indu Prakash & Rama Krishna, "A text book of practical physics",25th ed., KitabMahal Publishers, Allahabad, 2003. [2] J.C.Mohanty&D.K.Mishra, "University Practical Physics", Ist ed., Kalyani Publishers, 1990. [3] D.P.Khandelwal, "A laboratory manual of Physics" Isted.,Vani educational books , 1991. [4] Dr.Y.Aparna & Dr.K.VenkateswaraRao, "Laboratory manual of engineering physics", Ist ed., VGS Publications,2010.
E-resources and other digital material	[1] http://plato.stanford.edu/entries/physics-experiment/[2] [2] http://www.physicsclassroom.com/The-Laboratory[3] [3] http://facstaff.cbu.edu/~jvarrian/physlabs.html

14MA1301: COMPLEX ANALYSIS AND NUMERICAL METHODS

Course Category:	Institutional Core	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial- Practice:**	4 -1 - 0
Prerequisites:	Algebra of Complex numbers, Convergence of infinite series, Theory of equations.	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Determine analytic and non analytic functions and understand the concept of complex integration.											
	CO2	Analyze Taylor and Laurent series and evaluation of real definite integrals using residue theorem and understand the concept of transformations.											
	CO3	Solve Algebraic and transcendental, system of equations and understand the concept of polynomial interpolation.											
	CO4	Understand the concept of Numerical differentiation and integration. Solve initial and boundary value problems numerically.											
Contribution of Course Outcomes towards achievement of Program Outcomes (M-Medium, H–High,L-Low)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H				M		M					
	CO2	H				M		M					
	CO3	H	M			H						M	
	CO4	H	M			H						M	

Course Content

UNIT-I **[Text Book-1]**

Complex Analysis:

Introduction, continuity, Cauchy-Riemann equations. Analytic functions, Harmonic functions, Orthogonal systems, Complex integration, Cauchy's integral theorem, Cauchy's integral formula.

UNIT-II **[Text Book - 1]**

Taylor's series,Laurent's series, Zeros and singularities. Residue theorem,calculation of residues, evaluation of real definite integrals (by applying the residue theorem).

Standard transformations: Translation - Magnification and Rotation – Inversion and reflection - Bilinear transformation

UNIT –III **[Text Book-1]**

Numerical Methods:

Solution of Algebraic and Transcendental Equations : Introduction, Newton - Raphson method, Solution of simultaneous linear equations – Gauss Elimination Method - Gauss - Seidel iterative method.

Interpolation:

Introduction, Finite Differences – Forward, Backward, Central Differences, Symbolic

	Relations, Differences of a polynomial, Newton's formulae for interpolation, Central difference interpolation formulae –Gauss's, Sterling's, Bessel's formulae Interpolation with unequal intervals – Lagrange's and Newton's Interpolation formulae. **UNIT IV** **[Text Book - 1]** **Numerical Differentiation And Integration**: Finding first and second order differentials using Newton's formulae. Trapezoidal rule and Simpsons 1/3rd Rule ,3/8th rule. **Numerical Solutions of Differential Equations**: Taylor's series method Picard's method. Euler's method, Runge - Kutta method of 4th order, Boundary value problems, Solution of Laplace's and Poisson's equations by iteration.
Text books and Reference books	**Text Book(s):** [1] B.S.Grewal ,'Higher Engineering Mathematics', 42nd Edition, Khanna Publishers, 2012. **Reference Books**: [1] Krezig ,"Advanced Engineering Mathematics",8th Edition, JohnWiley& sons,2007. [2] R.K.Jain and S.R.K.Iyengar ,"Advanced Engineering Mathematics", 3rd Edition, Narosa Publishers. [3] N.P.Bali, Manish Goyal ,"Engineering Mathematics", 1st Edition Lakshmi Publications (P) Limited,2011. [4] H.K.Das, Er. RajnishVerma, "Higher Engineering Mathematics" 1st Edition, S.Chand ,2011. [5] S. S. Sastry, "Introductory Methods of Numerical Analysis", Print ice Hall of India , 2005.
E-resources and other digital material	

14EE3302 – ELECTRONIC CIRCUITS - I

Course Category:	Programme core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4- 0- 0
Prerequisites:	Engineering Physics(14PH1202), Basics of Electronics Engineering (14EC1206).	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Analyze and design basic diode circuits related to various applications .											
	CO2	Analyze and design different transistor biasing circuits, stabilization and compensation circuits											
	CO3	Analyze the behavior of BJT and FET at low frequencies.											
	CO4	Analyze the behavior of BJT and FET at high frequencies.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	M	L		L							
	CO2	H	L			H							
	CO3			M		H							
	CO4			M		H							

Course Content

UNIT- I **[Text Book-1,2]**

Semiconductor-Diode Characteristics:

Review of Semi conductor technology,the temperature dependence of p-n characteristics, Diode resistance, Space charge or transition capacitance, Diffusion capacitances, Diode switching circuits, Zener diode, Schottky diode, and Tunnel diode.

Special-purpose diodes:

Light-emitting diodes, Laser diodes, Photodiodes, Solar cells, Varactor diode, PIN diode.

Applications of Diodes:

Diode Approximations, Series Diode configurations with DC inputs, parallel and series – parallel configurations with DC inputs, Diode as a Rectifier, Half wave, Full wave (Centre-tapped) and Bridge Rectifiers without filter and with inductor filter, Capacitor filter, L- section and π - section filters, multiple L- section, multiple π- section filters, Clippers, Clampers, Zener diode as Voltage regulator.

UNIT- II **[Text Book-2]**

Transistor & FET Biasing:

Introduction**,** Operating Point, Biasing Circuits- Fixed Bias, Collector to base bias, Self bias, Stability factors, Bias Compensation circuits- Diode compensation for V_{BE} and $I_{CO,}$ Thermistor and Sensistor Compensation, Thermal runaway and thermal stability, JFET

	biasing Circuits- Fixed Bias, Self Bias, Voltage Divider Bias. **UNIT- III** **[Text Book-2]** **Transistor Amplifiers at Low frequencies** ***BJT Amplifiers:*** Hybrid parameter model of transistor, Determination of h-parameters from Characteristics, Measurement of h-parameters, Analysis of transistor amplifier using h- Parameter model. ***FET Amplifiers:*** FET Amplifiers at low frequencies, CS/CD/CG configurations at low frequencies. **UNIT- IV** **[Text Book-2]** **Transistor Amplifiers at High frequencies:** ***BJT Amplifiers:*** BJT at high frequencies, Hybrid π - model, CE short circuit current gain without load, CE short circuit current gain with resistive load, single stage CE transistor amplifier response, Emitter follower at high frequencies, gain bandwidth product. ***FET Amplifiers:*** FET amplifier at high frequencies – CS/CD amplifiers.
Text books and Reference books	**Text Book(s):** [1] Robert L Boylested and Louis Nashelsky, *"Electronic Devices and Circuit Theory"*, PHI, Eighth edition, 2003**.** [2] Jacob Millman, Christos C Halkias&Satyabrata JIT, *"Millman's Electronic Devices and Circuits"*,3rd edition, Tata Mc Graw Hill Ltd, 2007 . **Reference Books:** [1] Jacob Millman and Christos C Halkias, *"Integrated Electronics: Analog and Digital Circuits and Systems"*, TMH, 2003. [2] G .K. Mithal*" Electronic Devices and Circuits"* Khanna Publishers [3] S Salivahana*" Electronic Devices and Circuits"* TMH, 2nd Edition. [4] David A Bell *"Electronic Devices and Circuits"* 4th edition, PHI, 2003 **Note:** Special purpose diodes content available in e-book.
E-resources and other digital material	[1] Tony R. Kuphaldt, "Electric Circuits, Volume III –Semiconductors ",5th Edition, 2009 (e-book). [2] http://nptel.iitm.ac.in/courses.php?branch=Ece [3] www.ibiblio.org/obp/electricCircuits

14EE3303 - NETWORK ANALYSIS-I

Course Category:	Programme core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 1 - 0
Prerequisites:	Basics of Electrical Engineering (14EE1205)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Analyze DC circuits using different methods and formulate network matrices using graph theory.
	CO2	Analyze AC circuits and apply appropriate Network theorem for solving electric circuits
	CO3	Understand series and parallel resonance concepts and analyze coupled circuits.
	CO4	Analyze poly phase circuits and demonstrate power measurement techniques.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H			H						L	
CO2	H	H			H						L	
CO3	M	H			M							
CO4	M	H			H							

Course Content

UNIT-I **[Text Book-1]**

Electric Circuits:

Review of basics of Electrical circuits and Star-Delta Transformations, Source Transformations, Kirchhoff's laws, Mesh and Super mesh analysis. Node and super node analysis, power & energy calculations.

Network Topology:

Graph of a Network, Definitions associated with graph, formation of incidence matrix, loop matrix and cut - set matrices. Relationship between Branch Voltage Matrix, Twig Voltage matrix and Node voltage matrix. Relationship between branch current Matrix and Loop current matrix, Duality.

UNIT–II **[Text Book-1]**

Single Phase AC Circuits: Review of AC circuits, Phasor representation of alternating quantities- Mathematical representation of Phasors–Behavior of pure resistor, Inductor and capacitor in ac circuits. Series RL circuit, RC circuit and RLC circuit – Parallel AC circuits - , instantaneous power, average power, calculation of average power for periodic non-sinusoidal wave forms. Complex Power, Comparison of Power Terminology.

Network Theorems (Application To DC & AC Networks): Nodal and Mesh Analysis, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power transfer theorem, Reciprocity theorem, Millman's theorem, Tellegen's theorem and Compensation Theorem.

	UNIT–III **[Text Book-2]** **Series and Parallel Resonance:** Series Resonance, Impedance and Phase angle of a Series Resonant circuit, Voltages and Currents in a Series Resonant circuit, Bandwidth of an RLC circuit, The Quality factor (Q) and its effect on Bandwidth, Magnification in Series Resonance. Parallel Resonance, Resonant frequency for a tank circuit, Variation of Impedance with frequency, Q factor of Parallel Resonance, Magnification in Parallel Resonance, Reactance curves in Parallel Resonance. Locus diagrams-current locus diagrams for RL and RC series circuits. **Coupled Circuits:** Introduction, Conductively coupled circuits and mutual Impedance, Mutual Inductance, Dot convention, Coefficient of Coupling, Ideal Transformer, Analysis of Multi-Winding Coupled Circuits, Series connection of coupled Inductors, Parallel connection of coupled coils. Tuned circuits – Single tuned and double tuned circuits. **UNIT–IV** **[Text Book-2]** **Polyphase Circuits:** Polyphase System, Advantages of Three-Phase System, Generation of Three-Phase Voltages, Phase Sequence, Inter Connection of Three-Phase Sources and Loads, Voltage, Current and Power in a Star Connected System. Voltage, Current and Power in a Delta Connected System. Three-phase balanced and unbalanced circuits. **Power Measurement in Three-Phase Circuits**: Power in three phase circuits – Three wattmeter and Two wattmeter methods, Power Factor of balanced circuits by two wattmeter method, Variation in wattmeter readings with load power factor (lag and lead p.f. loads), Measurement of reactive power with two watt meter and single wattmeter. Power factor of an unbalanced system.
Text books and Reference books	**Text Book(s):** [1] Ravish R Singh,“ Network Analysis and Synthesis”, Tata Mc.Graw Hill,1st edition, 2011. [2] A.Sudhakar and ShyammohanS.Palli , “Circuits &Networks Analysis and Synthesis ”, 3rd ed., Tata McGraw-Hill, New Delhi, 2007 [3] W.D.Stevenson. Jr, “Elements of Power System Analysis”, by, Mc.Graw Hill, 4th Edition, 1982. **Reference Books:** [1] W.H.Hayt, J.E.kemmerly and S.M.Durbin, Engineering Circuit Analysis, 8th Edition, Tata McGraw-Hill, New Delhi, 2012. [2] Charles K. Alexander, Matthew N. O. Sadiku, Fundamentals of Electric Circuits, 5th Edition, McGraw-Hill, 2012. [3] A. Chakrabarti,“Circuit Theory (Analysis and Synthesis)”, 5th Edition, Dhanpat Rai& Co. Delhi, 2008.

E-resources and other digital material	http://nptel.ac.in/courses.php?branch=eee http://en.wikipedia.org/wiki/Electrical http://ocw.mit.edu/courses/audio-video-courses/#electrical-engineering-and-computer-science

14HS1304: ENVIRONMENTAL STUDIES

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Conservation and Preservation of Environment	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:										
	CO1	Understand the various natural resources, analyze and explore.										
	CO2	Understand the Ecosystems and need of Biodiversity										
	CO3	Realize and Explore the Problems related to Environmental pollution										
	CO4	Apply the Role of Information Technology and analyze social issues degradation management and its management Acts associated with Environment.										
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	L							H				L
	CO2			L				L	H				
	CO3				L		H						
	CO4				L				H	H			

Course Content

UNIT I **[Text Book-1]**

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. Timber extraction, 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 using mineral resources.

(d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

(e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.
(f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT II **[Text Book-1]**

Ecosystems:

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- Forest ecosystem ,Grassland ecosystem, Desert ecosystem ,Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

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.

UNIT III **[Text Book-1]**

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 hazards

Solid waste management-Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution,
Disaster management: Floods, earthquake, cyclone and landslides

UNIT – IV **[Text Book-1]**

Social Issues and the Environment

From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns, Environmental ethics- Issues and possible solutions.
Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wastel and reclamation, Consumerism and waste products.
Environment Protection Act: Air (Prevention and Control of Pollution) Act., Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.

	Human Population and the Environment: Population growth, variation among nations, Population explosion—Family Welfare Program., Environment and human health, Human rights, Value education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in environment and human health. **Field Work/Case Studies (**NOT TO BE INCLUDED IN SEMESTER END EXAMS**)** 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.
Text books and Reference books	**Text Book(s):** [1] Text book for "Environmental Studies" for under graduate courses of all branches of higher education – Erach Bharucha -- For University Grants Commission **Reference Books:** [1] AnjaneyuluY,"Introduction to Environmental sciences", B S Publications PVT Ltd, Hyderabad
E-resources and other digital material	colleges@edu.ac.in/UG/Envinromental%20**Studies**_ebook.**pdf**

14EE3305: DC MACHINES

Course Category:	Programme core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 1 - 0
Prerequisites:	Basics of Electrical Engineering (14EE1205)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Explain the concepts of Electromechanical Energy Conversion.
	CO2	Discuss and analyze construction, operation and performance of DC Generator
	CO3	Analyze the speed control of dc motors, parallel operation of DC generators.
	CO4	Analyze the performance of DC motor and understand the basic concepts of BLDC Motor.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)(L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M		H		H					
CO2	M	H	H		H		H					
CO3	M	H	H		H		H					
CO4	M	H	L		H		H					

Course Content

UNIT–I **[Text Book-1]**

Principles of Electromechanical Energy Conversion

Energy In Magnetic Systems, Field Energy and Mechanical Force, Doubly Excited Systems, Forces and Torques in Systems with Permanent Magnets, Energy Conversion via Electric Field, Dynamical Equations of Electromechanical Systems

UNIT–II **[Text Book-1]**

DC Generators - Construction & Operation Analysis:

Principle, constructional features and operation of DC generators, EMF equation, Methods of Excitation, Types of Windings – lap and wave (SIMPLEX and DUPLEX only)

Armature Reaction:

Armature reaction & compensations, commutation and interpoles, Building up of EMF-Critical resistance & Critical Speed for shunt and series generators.

Characteristics and Parallel Operation:

No load and load characteristics of all types of DC generators, their applications and parallel operation

UNIT–III **[Text Book-1]**

DC Motors-Operation & Analysis

	Principle, operation of DC motors, Torque equation, Characteristics of different types of DC motors, applications, speed control of DC shunt, series and compound motors, DC motor starters and their design **UNIT-IV** **[Text Book-1]** **Performance Testing:** Losses, efficiency and testing of DC machines - Brake test, Swinburne's, Hopkinson's, Retardation test and Field's Test. **BLDC Motor**: Introduction to BLDC motor, comparison of BLDC with DC motor, Schematic and operation, circuit model and characteristics.
Text books or Reference books	**Text Book(s):** [1] D.P. Kothari and I.J.Nagrath, " Electric Machines" 4th edition,,TataMcGraw- Hill,2006 **Reference Books:** [1] A.E.Clayton, "The Performance & design of D.C.Machines",1st edition,CBS publisher& Distributors,2003 [2] Fitzgerald &Kingsley,S.D. Umans"Electric Machinery", 6thedition, McGraw-Hill,2005 [3] AshfaqHussain,"Electric Machines" 2ndedition, Dhanpathrai & Co,2014 [4] Dr.P.S.Bhimbra,"Electrical Machinery", 7th edition, Khanna Publishers,2009.
E-resources and other digital material	http://nptel.ac.in/courses/108105017/

14EE3306: DIGITAL CIRCUITS AND SYSTEMS

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Linear Algebra and Differential Equations (14MA1101) Basics of Electronics Engineering(14EC1206)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Elucidate the binary codes, Boolean algebra and simplifying the switching functions.											
	CO2	Design and implement combinational logic circuits.											
	CO3	Design and implement flip flops and sequential logic circuits.											
	CO4	Explain various logic families and their importance in digital IC characteristics.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	H			M							
	CO2	M	H	H		H							
	CO3	L	H	H		H					L		
	CO4	L	H	M		L					H		

Course Content

UNIT – I **[Text Book - 1]**

Number Systems:

Sign-Magnitude Representation, One's Complement Representation, Two's Complement Representation, Binary Addition, Binary Subtraction, Binary Multiplication, Binary Division. 2's compliment Arithmetic - Addition/Subtraction in 2's compliment, Excess-3 code, Gray code, Octal Code, Hexadecimal Code, Error detecting and Correcting Codes- Error detecting Codes, Error Correcting Codes.

Minimization of Switching Functions:

Simplification of Logical functions using Karnaugh map method (Two, Three and Four variable), Don't-Care conditions, Quine-Mc Cluskey Minimization technique (Two, Three and Four variable), Determination of prime implicants, Selection of prime implicants.

UNIT-II **[Text Book - 1]**

Combinational Logic Design:

Half-Adder, Full-Adder, Half-Subtractor, Full-Subtractor, BCD-to -7-Segment decoder, Design of a Binary-to-Gray code converter, Design of a Gray -to-Binary code converter, Hazards and hazard free realizations.

	Combinational Logic Circuits Using MSI Circuits: Multiplexers and their use in combinational logic design- Multiplexer, combinational logic design using Multiplexers, DeMultiplexers / Decoders and their use in combinational logic design, Carry Look-Ahead adder, Parity Generator, Priority Encoders- decimal to BCD Encoder, Octal to Binary Encoder, ALU. **Programmable Logic Devices:** Read Only Memory, ROM Organization, Design of a combinational circuit using a ROM, Programmable Logic Array (PLA), PLA Programming Table, Programmable Array Logic (PAL). **UNIT-III** **[Text Book - 1]** **Flip-Flops:** Flip-Flops – Clocked SR flip-flop, Preset and Clear, JK flip-flop- Race Around Condition, Master Slave JK flip-flop, D-Type flip-flop, T -Type flip-flop, Excitation table of flip-flop, flip flop conversions. **Sequential Logic Design:** Shift register, Bi-directional Shift register, Applications of Shift Registers, Ring counter, Johnson counter, Sequence generator, Universal Shift Register, Asynchronous Counters- UP/DOWN Counters, Modulus of the Counter, Design of Asynchronous Counters, Synchronous counters- Synchronous counter design, Lock-Out, Clocked Sequential Circuit Design using State diagrams and Excitation tables. **UNIT – IV** **[Text Book - 1]** **Logic Families:** Characteristics of Digital IC's, Direct-Coupled Transistor logic, Resistor-Transistor logic, Diode-Transistor logic, Transistor-Transistor logic, Schottky TTL, Emitter-Coupled logic, Integrated-Injection logic, High Threshold logic (HTL), MOSFET Characteristics – Switching action of MOSFET, NMOSFET as a Resistor, NMOS as an Inverter, NAND and NOR gates, CMOS Logic – CMOS as an Inverter, NAND and NOR gates .
Text books and Reference books	**Text Book(s):** [1] R P Jain : Modern Digital Electronics, 4th Edition TMH [2] M. Morris Mano, "Digital Logic and ComputerDesign". PHI, 2003. **Reference Books:** [1] Taub& Schilling," Digital integrated electronics", McGraw-Hill [2] A. AnandKumar," Fundamentals of Digital Circuits", 2nd Edition, PHI [3] Gordon J Deboo&Clifford N. Burrous," Integrated Circuits and Semiconductor Devices", International StudentEdition, 2nd Edition, McGraw-Hill.
E-Resources and other digital material	[1] **http://www.nptel.ac.in/courses/117106086/** [2] http://www.docstoc.com/docs/14901337/Fundamentals-of-Digital-Electronics [3] http://www.ebookee.com/Fundamentals-of-Digital-Electronics_313329.

14EE3351: ELECTRICAL NETWORKS AND MACHINES LABORATORY – I

Course Category:	**Programme core**	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 0 – 3
Prerequisites:	DC Machines(14EE3305), Network Analysis I (14EE3303)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Design and conduct experiment.											
	CO2	Analyze and present experimental results.											
	CO3	Exhibit professional behavior											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1		H	L	H								
	CO2				H			H					
	CO3				H			H					

Course Content

Networks Lab:

1. Verification of KCL & KVL
2. Verification of Thevenin's & Maximum power transfer theorems
3. Verification of Superposition & Reciprocity theorems.
4. Determination of parameters of choke coil
5. Locus Diagrams of R-C and R-L circuits
6. Measurement of single phase power in an RL circuit
7. Series resonance
8. Estimation of self & mutual inductance of coupled circuits

Electrical Machines Lab:

1. No load & load characteristics of separately excited generator.
2. Load test on DC series generator.
3. Load test on DC compound Generator

	4. Speed control of DC shunt motor 5. Brake test on DC shunt motor 6. Brake test on DC compound Motor 7. Field's test on DC Series Motor 8. Swinburne's Test 9. Hopkinsson's Test 10. Retardation Test 11. Trouble shooting of DC motor

NOTE: In all laboratories a minimum of 10 experiments are to be completed.
(Minimum five experiments from networks and Mininimum five from Machines)

14EE3352 - ELECTRONICS LABORATORY – I

Course Category:	Programme core	**Credits:**	2
Course Type:	**Practical**	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:	Basics Of Electronics Engineering(14EC1206)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Design and conduct experiment.											
	CO2	Analyze and present experimental results.											
	CO3	Exhibit professional behavior											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1		H		H								
	CO2				H			H					
	CO3				H			H					

Course Content

ELECTRONIC DEVICES LAB:

1. Characteristics of PN Junction Diode and Zener Diode.
2. Characteristics of LED and Photo Diode.
3. Analysis of Half Wave & Full Wave Rectifiers with and without filter.
4. Characteristics of Transistor in Common Base Configuration.
5. Characteristics of Transistor in Common Emitter Configuration.
6. Verification of Transistor Self-Bias Circuit.
7. Characteristics of Junction Field Effect Transistor
8. Characteristics of Unijunction Transistor.

DIGITAL ELECTRONICS LAB:

1. Realization of logic gates Using Discrete Components and Universal gates.
2. Implementation of the given Boolean Function Using Logic Gates in both SOP and POS forms.
3. Implementation of 4-bit Parallel Adder/ Subtract or Using IC 7483.
4. Design of Binary to Gray and Gray to Binary Converters.
5. Verification of Flip-Flops Using Logic Gates.
6. Design and Verification of Synchronous and Asynchronous counters using flip flops and IC 74163.
7. Verification of UP/DOWN Counters using IC 74193.
1. Design and Verification of MUX and DEMUX.

NOTE: In all laboratories a minimum of ten experiments are to be completed.
Minimum five from Electronic Devices and Minimum five from Digital Electronics

14MA1401: TRANSFORMATIONS AND PROBABILITY DISTRIBUTION

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture- Tutorial- Practice:**	3 -1 - 0
Prerequisites:	Basic concepts of probability and statistics	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Analyze general periodic functions in the form of an infinite convergence series of sines and cosines**.**											
	CO2	Apply Fourier Transforms and Z- Transforms to evaluate indefinite integrals and engineering problems.											
	CO3	Understand the probability densities of continuous random variables for different distributions											
	CO4	Understand the concept of sampling distribution, estimate correlation, regression coefficients											
Contribution of Course Outcomes towards achievement of Program Outcomes (M-Medium, H–High,L-Low)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	M			M		M				M	
	CO2	H	M			M		M				M	
	CO3	H	H			H		H		L		M	
	CO4	H	H			H		H		L		M	

Course Content

UNIT-I **[Text Book-1]**

Fourier Series: Introduction, Euler's Formulae, Conditions for a Fourier expansion, Functions having points of discontinuity, change of interval, odd and even functions, Expansions of odd and even periodic functions, Half - range series, Parseval's formula, complex form of Fourier series. Practical harmonic analysis.

UNIT-II **[Text Book - 1]**

Fourier Transforms: Introduction, Definition, Fourier integrals, Fourier sine and cosine integrals - complex form of Fourier integrals. Fourier transforms, Fourier sine and cosine transforms - Finite Fourier sine and cosine transforms, Fourier transforms of the derivatives of a function, Parseval's Identity for Fourier Transforms.

Z-Transforms: Definition, Some Standard Z-Transforms, Linearity Property, Damping Rule, Some Standard Results, Shifting μ_n to the Right, Multiplication by 'n', Two Basic Theorems.

UNIT –III **[Text Book-2]**

Probability Densities: Continuous random variables – Normal distribution – Normal approximation to the binomial distribution – Other probability densities – Uniform distribution – Log – Normal distribution – Gamma distribution – Beta distribution – Weibull distribution – joint distributions – Discrete and continuous checking if the data are normal – Transforming observations to near normally.

	UNIT IV **[Text Book – 1,2]** **Sampling Distributions:** Populations and samples – Sampling distribution of the mean (SD known) – Sampling distribution of the mean (SD unknown) – Sampling distribution of the variance. **Statistics**: Method of Least Squares – correlation – Regression
Text books and Reference books	**Text Book(s):** [1] B.S. Grewal , "Higher Engineering Mathematics" by, 42nd edition ,Khanna Publishers, New Delhi, 2012 [2] Richard A.Johnson , "Probability and statistics for Engineers",Prentice Hall of India. **Reference Books:** [1] Krezig, "Advanced Engineering Mathematics" 8th Edition, JohnWileyand sons,2007. [2] H.K.Das, Er. RajnishVerma ,"Higher Engineering Mathematics", 1st edition, S.Chand,2011. [3] T.K.V.Iyengar, "Probability and Statistics" 4th edition, S.Chandand Company, 2012 [4] Rukmangadachari E, "Probability and Statistics", Pearson, 2012
E-resources and other digital material	[1] probweb.berkekey.edu/teaching.html [2]statsci.org/teaching.html [3] mathworld.wolfram.com/fourierseries.html [4] www.thefouriertransform.com .

14EE3402: ELECTRONIC CIRCUITS-II

Course Category:	Programme core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3- 0 - 0
Prerequisites:	Engineering Physics(14PH1202) Basics of Electronics Engineering(14EC1206) Electronic Circuits-I(14EE3302)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Analyse Multi stage amplifier circuits at low frequency and high frequencies.											
	CO2	Design power amplifiers**.**											
	CO3	Design Feedback amplifiers.											
	CO4	Analyze tuned amplifiers.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M				H							
	CO2	M				H							
	CO3					H							
	CO4					H							

Course Content

UNIT-I **[Text Book-1]**

Multistage Amplifiers

Classification of Amplifiers, Distortion in amplifiers, Frequency response of an amplifier, Frequency response of an amplifier to step input, Low frequency response of RC coupled amplifier, Effect of emitter bypass capacitors on low frequency response, High frequency response of two cascaded CE transistor stages, CE-CB Cascade Amplifier, CC-CC Darlington pair.

UNIT-II **[Text Book-1]**

Power Amplifiers

Classification of Power amplifiers, Design and analysis of Direct-Coupled Class A, Transformer Coupled Class A, Class B, Direct Coupled, and Transformer coupled Push-Pull, Complementary Symmetry Push-Pull, Class C power amplifiers, Class D power amplifier, and Harmonic distortion in amplifiers.

UNIT-III **[Text Book-2]**

Feedback Amplifiers

Feedback concepts, General characteristics of Negative feedback Amplifiers, Feedback

	Connection types, Analysis of Voltage series, Current series, Voltage shunt, Current shunt feedback amplifiers. **UNIT-IV** **[Text Book-2]** **Tuned Amplifiers** The parallel resonance circuit, Single tuned amplifier, Tuned primary amplifier, Tuned secondary FET amplifier, Double tuned transformer coupled amplifier, Stagger tuned amplifier and synchronously tuned amplifier.
Text books and Reference books	**Text Book(s):** [1] G.KMithal, "Electronic Devices and circuits",Khanna Publishers [2] John D Ryder, "Electronic Fundamentals and Applications: Integrated and Discrete Systems", 5th edition, PHI, 2003. **Reference Books:** [1] Jacob Millman and Christos C Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems", TMH, 2003 [2] Robert Boylestad and Louis Nashelsky, "Electronic Devices and circuits", 9th edition, PHI.
E-resources and other digital material	[1] http://nptel.iitm.ac.in/courses.php?branch=Ece [2] http://en.wikipedia.org/wiki/Electronics [3] www.allaboutcircuits.com [4] www.tomsic.biz [5] http://www.electronics-tutorials.ws/amplifier/amp_1.

14EE3403 NETWORK ANALYSIS – II

Course Category:	Programme core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 1 - 0
Prerequisites:	Linear Algebra and differential Equations(14MA1101) Basics of Electrical Engineering (14EE1205)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Analyze transient response of electric circuits.											
	CO2	Find network functions and two-port parameters.											
	CO3	Apply Fourier analysis to analyze electric circuits and design the filters.											
	CO4	Synthesize one port and two port networks.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	M			H						M	
	CO2	H	M	L		H							
	CO3	H				H						L	
	CO4	H		H		H							

Course Content

UNIT-I **[Text Book-1]**

Transients:

Review of Laplace transforms- Introduction, Direct current Transients – RL Transient, RC Transient, RLC Transient, twomesh transients. Alternating Current Transients - RL, RC, and RLC circuits, two mesh transients. (Both Differential equation and Laplace Transform approaches).Response of RL,RC and RLC circuits to Periodic functions.

UNIT–II

Network Function: **[Text Book-2]**

Introduction, Concept of complex frequency, Driving point functions, Transfer functions-Definition of operational/ transformed impedances and admittances of L, C and transform with initial conditions; development of transformed networks incorporating initial conditions as sources and solution of transformed networks. Analysis of ladder and non-ladder networks; Poles and Zeros of network functions; Restrictions on poles and zeros for driving- point and transfer functions. Time domain behavior from pole zero plot, Graphical method for determination of residue

Two Port Networks: **[Text book-1]**

Introduction, Port in a network, Network configuration, Open circuit impedance parameters, short circuit admittance parameters, transmission (ABCD) parameters, hybrid

	parameters, Condition of symmetry and reciprocity in two port parameter representation, interrelation between parameters of two port networks, inter connection of 2-port networks, image parameters, Network functions for the Two-Port bridged – T, π, Ladder and Lattice networks. **UNIT–III** **Fourier Circuit Analysis**: **[Text Book 2]** Introduction, Trigonometric form of the Fourier series, Exponential form of the Fourier series , Wave form symmetry, Average Value and RMS value of a periodic Complex wave, Power supplied by complex wave, Definition of the Fourier Transform, Some properties of the Fourier Transform, The Fourier Transform of some useful functions and periodic function, Energy density spectrum. **Filters**: **[Text Book 1]** Introduction, Classification of Filters, Filter networks-Low pass, high pass, band pass and band stop, Analysis and design of prototype Filter networks both T and π configurations, Analysis of m-Derived Filter networks. **UNIT–IV** **[Text Book-1]** **Network Synthesis:** Concept of stability of a system- Hurwitz polynomials and properties – Positive real functions and its properties – concept of Network Synthesis ,Summary of procedure of synthesis, Reactive networks-properties, pole zero interpretation and Synthesis of LC, RL and RC of one port and two port networks-Foster form , Cauer form.
Text books and Reference books	**Text Book(s):** [1] A.Chakrabarthi,"Circuit Theory (Analysis and Synthesis),", 6th ed., DhanpatRaiand Co.(PVT) Ltd., 2013. [2] Ravish R Singh ,"Network Analysis and Synthesis", 1st ed., McGraw-Hill Education (India) Pvt. Ltd., New Delhi. **Reference Books:** [1] M.E Van Valkenburg, Network Analysis, 3rd edition Prentice Hall of India, PvtLtd,New Delhi. [2] W.H.Hayt, J.E.kemmerly and S.M.Durbin, Engineering Circuit Analysis, 8th Edition, Tata McGraw-Hill, New Delhi, 2012 . [3] Charles K. Alexander, Matthew N. O. Sadiku, Fundamentals of Electric Circuits, 5th Edition, McGraw-Hill, 2012. [4] A.Sudhakar and P.Shyam Mohan, Circuits and Networks Analysis and Synthesis, 3nd Edition, Basic Electrical Engineering, Tata McGraw-Hill, New Delhi, 2007
E-resources and other digital material	[1] http://nptel.ac.in/courses/108102042/

14EE3404 – ELECTROMAGNETIC FIELD THEORY

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Engineering Physics (14PH1202), Calculus (14MA1201) Linear Algebra and Differential Equations (14MA1101)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Elucidate the concepts of three coordinate systems and estimate electric field intensity and electric potential due to various static charge distributions
	CO2	Understand the concepts of Electric fields in material space and solve electrostatic boundary value problems
	CO3	Estimate Magnetic field intensity due to various current configurations and understand the concepts of magnetic forces in material space.
	CO4	Understand Maxwell's equations and electromagnetic wave propagation and solve field problems involving static and time varying fields.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H				H		H					
	CO2	H				H		H					
	CO3	H				H		H					
	CO4	H				H		H					

Course Content

UNIT I **[Text Book-1]**

Introduction to Coordinate Systems and Vector Calculus:
Cartesian, cylindrical and spherical coordinate systems. Differential length, area and volume. Line, surface and volume integrals. Del operator, gradient of a scalar, divergence of a vector and divergence theorem. Curl of a vector and Stokes Theorem. Laplacian of a scalar.

Electrostatics:
Coulomb's law and field intensity, Electric fields due to continuous charge distributions, Electric flux density. Gauss's law – Maxwell's Equation, applications of Gauss's law, Electric potential, relationship between **E** and V – Maxwell's Equation, an electric dipole and flux lines, energy density in electrostatic fields.

UNIT II **[Text Book-1]**

Electric Fields in Material Space:
Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, dielectric constant and strength, continuity equation

	and relaxation time, boundary conditions. **Electrostatic Boundary Value Problems:** Poisson's and Laplace's equations, Uniqueness theorem, general procedures for solving Poisson's and Laplace's equations, resistance and capacitance, method of Images. **UNIT III** **[Text Book-1]** **Magneto Static Fields:** Biot-Savart's law, Ampere's circuit law – Maxwell's equation, applications of Ampere's law, Magnetic flux density – Maxwell's equation, Magnetic scalar and vector potentials. **Magnetic Forces, Materials and Devices:** Forces due to magnetic fields, magnetic torque and moment, magnetic dipole, magnetization in materials, magnetic boundary conditions, inductors and inductances, magnetic energy. **UNIT – IV** **[Text Book-1]** **Maxwell's Equations:** Faraday's law, transformer and motional electromotive forces, displacement current, Maxwell's equations in final forms, time harmonic fields. **Electromagnetic Wave Propagation:** Wave propagation in lossy dielectrics, plane waves in lossless dielectrics, plane waves in free space, plane waves in good conductors, power and Poynting vector.
Text books and Reference books	**Text Book(s):** [1] Matthew N.O.Sadiku, "Principles of Electromagnetics", 4th edition, Oxford University Press, New Delhi, 2009 **Reference Books:** [1] W.H.Hayt and J.A.Buck, "Engineering Electromagnetics", 7th edition, Tata McGraw Hill, New Delhi, 2006 [2] Joseph A.Edminister, "Electromagnetics – Theory and problems", 2nd edition,Schaum's outline series, MCGraw Hill,1993 [3] K.A.Gangadhar and P.M. Ramanathan,"Field Theory", 15th edition,Khanna Publications, 2002.
E-resources and other digital material	---

14EE3405: TRANSFORMERS AND INDUCTION MOTORS

Course Category:	Programme core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 1 - 0
Prerequisites:	Basics of Electrical Engineering, (14EE1205); Network Analysis I(14EE3303);	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Describe the construction, operation and Estimate performance of single phase transformer
	CO2	Discriminate different winding connections of three phase transformer and Explain the operation of Auto transformer
	CO3	Understand the construction, operation, testing and analysis of different types of three phase induction motors and associated starters
	CO4	Discuss the speed control methods of 3-phase induction motor and understand the principle, starting methods of single phase induction motors

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)(L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M	H	H		H		H					
	CO2	M	H	H		L		H					
	CO3	M	H	H		H		H					
	CO4		H	H		M		H					

Course Content

UNIT–I **[Text Book-1]**

Transformers:

Constructional features and methods of cooling of transformers, ideal transformer, EMF equation, no load and load phasor diagram, equivalent circuit of single phase transformers, losses, per unitsystems, auto transformers.

Testing:

OC and SC tests, Sumpner's test,Regulation, efficiency and all day efficiency

UNIT–II **[Text Book-2]**

Three Phase Transformers

Three phase transformer windings and its connections star-star, star-delta, delta-star, delta-delta, zig-zag and Vector grouping. Open delta, Tertiary transformer winding, Scott connected transformers, Parallel operation of transformer with equal and unequal voltage ratios and its load sharing. Tap changing.

	UNIT–III **[Text Book-1]** **Polyphase Induction Motors:** Construction, Rotating magnetic field in three phase systems, operation of squirrel cage and slip ring 3-phase induction motors, torque equation and torque-slip characteristics, equivalent circuit, losses, efficiency, testing of induction motors and circle diagram. Types of starters, Crawling, Cogging, Double cage rotors, Induction generators and their applications. **UNIT-IV** **[Text Book-1]** **Speed Control of Three Phase Induction Motor:** Speed control of induction motors-Stator voltage control, frequency control, V/f control, pole changing and cascading, injection of EMF into rotor circuit (qualitative treatment only). **Single Phase Induction Motors:** Double field revolving theory, starting methods – split phase, capacitor start and run, shaded pole motors and their characteristics and applications, No-load and blocked rotor test, equivalent Circuit
Text books or Reference books	**Text Book(s):** [1] D.P.Kothariand I.J.Nagrath,"Electrical Machinery" 4th edition ,Tata McGraw-Hill-2006. **Reference Books:** [1] Alexander S.Langsdorf,"Theory of Alternating current machinery",35th reprint, Tata McGraw-Hill, 1999. [2] Dr.P.S.Bhimbra,"Electric Machinery" , 7th edition, Khanna Publishers, 2009. [3] AshfaqHussain,"Electric Machines", 2nd edition, DhanpathRaiandCo,2014.
E-resources and other digital material	--

14EE3406: ELECTRICAL MEASUREMENTS

Course Category:	Programme core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Basics of Electrical Engineering (14EE1205A),	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Elucidate the basic laws governing the operation of electrical measuring instruments and measure electrical quantities like Voltage and Current
	CO2	Understand the concepts used in watt meters and Industrial metering
	CO3	Understand the significance and working of instrument transformers and bridges used for electrical measurements
	CO4	Elucidate the concepts of potentiometers, digital voltmeters and transducers used for electric measurements

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)(L – Low, M - Medium, H – High)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	M									
CO2	M	H							L		M	
CO3	H	H	M									
CO4	M	M	M						L			

Course Content

UNIT–I **[Text Book-1]**

Analog Instruments:

Classification of analog Instruments, principles of operation.

Electro-Mechanical indicating instruments – operating forces, control systems, damping systems

Analog Ammeters and Voltmeters:

Permanent Magnet Moving Coil Instruments, Moving Iron Instruments, Electrodynamometer Instruments, Electrostatic Instruments.(Construction, General Torque equation, shape of scale, advantages, disadvantages and errors)

Measurement of Power:

Electrodynamometer wattmeters – Construction, theory, shape of scale, errors. Low power factor dynamometer wattmeters. Three phase wattmeters, Measurement of Reactive power.

UNIT–II **[Text Book-1]**

Measurement of Energy and Industrial Metering:

Single phase Induction type Watt-hour meters (Construction, theory of operation

	and adjustments), Industrial metering and Tariffs, Merz Price maximum demand indicator, measurement of VAh and VArh, testing of Energy meters by direct loading and phantom loading arrangements. **Measurement of Phase and Frequency:** **[Text Book - 1]** Power Factor meters – Electrodynamometer and Moving Iron Power Factor meters. Frequency meters – Mechanical Resonance and Electrical Resonance Frequency meters. Synchroscopes – Electrodynamometer and Moving Iron Synchroscopes. Phase sequence Indicators – Rotating and Static Phase sequence indicators. **UNIT–III** **[Text Book-1]** **Instrument Transformers:** Current Transformers – Theory, Ratio error and phase angle errors, Reduction of errors, effect of Secondary open circuit, testing of Current Transformers using Mutual Inductance method and Silsbee's method. Potential Transformers - Theory, Ratio error and phase angle errors, Reduction of errors, testing of Potential Transformers using Absolute null method and Wattmeter method. **DC & AC Bridges:** Measurement of Resistance - Wheatstone bridge, Kelvin double bridge. Measurement of Self Inductance - Maxwell's bridge, Hay's bridge, Anderson's bridge, Owen's bridge. Measurement of Capacitance – DeSauty's bridge, Schering bridge, High voltage Schering bridge. **UNIT-IV** **[Text Book-1]** **Potentiometers:** DC Potentiometers – Crompton's Potentiometer, Multiple-Range Potentiometer, Vernier Potentiometer, Brooks deflectional Potentiometer. AC Potentiometers – Drysdale Polar Potentiometer, Gall-Tinsley co-ordinate Potentiometer. **Digital Voltmeters:** Ramp, Integrating and potentiometric digital voltmeters. **Cathode Ray Oscilloscopes:** Basic CRO Circuits, Observation of Waveform on CRO, Measurement of Voltages and currents, measurement of phase and frequency (Lissajous Patterns), multi input oscilloscopes, dual trace oscilloscopes, dual beam oscilloscope, digital storage oscilloscope.
Text books or Reference books	**Text Book(s):** [1] A.K.Sawhney, "A course in Electrical & Electronic Measurements and Instrumentation",, 19th edition,Dhanapthirai& Co., New Delhi, 2013.

	Reference Books: [1] J.B.Gupta, "A course in Electronic & Electrical Measurements and Instrumentation", S.K.Kataria& Sons., New Delhi, 2009. [2] E.W.Golding and F.C.Widdis," Electrical Measurements and measuring instruments", 5th edition, Wheeler Publishers, New Delhi, 2009.
E-resources and other digital material	--

14EE3451: ELECTRICAL NETWORKS AND MACHINES LABORATORY-II

Course Category:	**Programme core**	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 0 – 3
Prerequisites:	Electrical Networks And Machines Laboratory – I (14EE3351)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Design and conduct experiment.											
	CO2	Analyze and present experimental results.											
	CO3	Exhibit professional behavior											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1		H	L	H							M	
	CO2				H			H				M	
	CO3				H			H					

Course Content

Networks Lab – II

1. Simulation of RLC circuits using PSPICE
   i) Steady state analysis ii) transient analysis
2. Verification of Maximum power transfer and superposition theorems using P-SPICE
3. Determination of Z, Y parameters of a given two port network
4. Harmonic analysis on single phase transformer
5. Generation of 6- Phase using Poly-phase connections of transformers
6. Series andParallel Resonance
7. Measurement of voltage and current in RLC circuit
8. Short circuit analysis of RLC circuit.
9. Voltage, Current and Power measurements in balanced and unbalanced three phase circuits using resistors.
10. Fourier analysis of an RLC circuit using PSPICE.

Electrical Machines Lab – II

1. OC and SC tests on single - phase transformer
2. Load test on single - phase transformer
3. Sumpner's test on Transformers
4. Scott Connection of Transformers

	5. Parallel Operation of Two Single - Phase Transformers 6. Load test on 3-phase transformer 7. Load test on 3 - phase squirrel cage induction motor 8. Load test on 3 - phase slip ring induction motor 9. No load and Blocked rotor test on 3 - phase induction motor 10. Brake test on single - phase induction motor 11. Determination of Equivalent Circuit of Single - Phase Induction Motor 12. Separation of Core Loss of a Transformer

NOTE**: In all laboratories a minimum of 10 experiments are to be completed.** (At least five experiments from Networks Lab and five from Electrical Machines Lab)

14EE3452 – ELECTRICAL MEASUREMENTS LAB

Course Category:	Programme core	**Credits:**	2
Course Type:	**Practical**	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:	**Basics of Electrical Engineering, (14EE1205);**	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Design and conduct experiment.											
	CO2	Analyze and present experimental results.											
	CO3	Exhibit professional behavior											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	H				L	M					
	CO2	M	H			L		M					
	CO3						L						

Course Content

LIST OF EXPERIMENTS

1. Measurement medium resistance using Wheatstone Bridge.
2. Measurement low resistance using Kelvin's Double Bridge.
3. Measurement of capacitance and loss tangent using Schering Bridge.
4. Measurement of Inductance and Quality factor using Anderson Bridge/Hays Bridge.
5. Calibration of single–phase energy meter by direct loading.
6. Calibration of single–phase energy meter by phantom loading
7. Measurement of displacement using LVDT
8. Measurement of strain using strain gauge
9. Measurement of dielectric strength of transformer oil
10. Measurement of frequency / Component testing using CRO
11. Tracing of B-H curve and measurement of hysteresis loss using CRO
12. Measurement of 3-phase reactive power with single Wattmeter
13. Frequency measurement by Wien's Bridge
14. Measurement of power supply parameters using network analyzer
15. Measurement of Ratio error and Phase angle error of C.T / P.T

NOTE: In all laboratories a minimum of 10 experiments are to be completed.

14HS1453: COMMUNICATION SKILLS LAB

Course Category:	Program core	**Credits:**	2
Course Type:	**Practical**	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:	Technical English and Communication skills –(14HS1104)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Be proficient in pronunciation of speech sounds including accentuation.											
	CO2	Enhance the awareness of the elements of listening comprehension.											
	CO3	Develop the abilities of rational argumentation and skills of public speaking.											
	CO4	Be aware of the elements of professional communication											
	CO5	Be exposed to the items of various competitive exams.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1							H	H	M			L
	CO2		M		H	M	M	H	H	M	H		M
	CO3	H	H	M	H		H	H	M	M	H	L	H
	CO4	M	M	M	H	L	H	H	H	H	H	L	H
	CO5		M	M	M	M	H	H	L	H	H	L	L

Course Content

UNIT: I

Elements of Spoken Expression and processes of Listening comprehension:

- Speech Mechanism
- Articulation of vowels and consonants
- Patterns of Accentuation
- Types and processes of Listening comprehension

UNIT II

Polemics and Public Speaking:

- Group Discussion
- Pyramid Discussion
- PNI
- Seminar Talk and Power Point Presentation.

UNIT III

Professional Communication:

- Self Affirmation

	➢ Advanced Composition including Official letters and e-mail ➢ Résumé Preparation ➢ Elements of Non-Verbal Communication. **UNIT IV** **Life Skills and Vocabulary for Competitive Examinations:** ➢ Select Life Skills(50) ➢ Select Logies, Isms, Phobias and Manias (25 each) ➢ Sentence Completion(50 items) ➢ Fundamentals of Syllogisms
Text books and Reference books	**Text Book(s):** [1] Martin Cutts," Oxford Guide to Plain English", 7th Impression, OUP, 2011 [2] Exercises in Spoken English, Prepared by Department of Phonetics and Spoken English, CIEFL, OUP, 21st Impression, 2003 **Reference Books:** [1] Stephen R Covey, "The 7 Habits of Highly Effective people", 2nd edition, (Pocket Books) Simon and Schuster UK Ltd, 2004 [2] Martin Cutts, "Oxford Guide to Plain English", 7th Impression, OUP, 2011 [3] Deborah. J. Bennett, "Logic made easy: How to know when Language Deceives you", 1st edition(Reprint), 2005 [4] Eclectic Learning Materials offered by the Department
E-resources and other digital material	[1] ODll Language Learner's Software, 27-6-2012 Orell Techno Systems , [2] Visionet Spears Digital Language Lab software Advance Pro , 28-01-2015 [3] www.natcorp.ox.ac.uk, *British National Corpus, XML edition 2007.*

14EE3501-LINEAR CONTROL SYSTEMS

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture- Tutorial- Practice:**	3 -1 - 0
Prerequisites:	Network Analysis II (14EE3404)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70 M 100 M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Determine transfer function models of electrical, mechanical and electromechanical systems											
	CO2	Analyze the behaviour of the system under time domain approach and graphical method.											
	CO3	Apply various plots to analyze the behaviour of the system under frequency domain approach and design of compensators											
	CO4	Determine State space models of various systems and analyze them											
Contribution of Course Outcomes towards achievement of Program Outcomes (M-Medium, H–High,L-Low)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	L			H				L			
	CO2	H	L			H				L			
	CO3	H	L			H				L			
	CO4	H	L			H				L			

Course Content

UNIT-I **[Text Book-1]**

Introduction:

Control system terminology, examples of simple control systems, open loop and closed loop control systems, effect of feedback on overall gain, stability, sensitivity, external noise; types of feedback control systems – linear, nonlinear, time invariant and time varying systems.

Mathematical Models of Physical Systems:

Formulation of differential equations for electrical, mechanical and electromechanical systems-AC Servomotor and DC servomotor, transfer functions of systems ,analogous systems, characteristic equation of feedback systems, poles and zeros, block diagram representation of control systems, block diagram algebra, signal flow graph, Mason's gain formula.

UNIT-II **[Text Book - 1]**

Time Domain Analysis:

Standard test signals – step, ramp, parabolic and impulse; Time response of first-order system to standard test signals, step response of second order system, time domain specifications, steady state error and static error constants.

Stability Analysis In Complex Plane:

Stability definitions, Stability study based on poles of closed-loop transfer function, Routh–

	Hurwitz criterion. Root locus concept, magnitude and angle conditions, properties and construction of the root loci (**For positive K only**) **Basic Controllers :** On-off, P, I, PI, PD and PID control actions, Designing of PID controllers – Ziegler-Nichols method. **UNIT –III** **[Text Book-1]** **Frequency Domain Analysis:** Introduction, frequency domain specifications, correlation between time and frequency response, polar plot, Bode plot, phase margin and gain margin - Principle of argument, Nyquist stability criterion **Compensation Techniques :** Introduction, Types of compensators, selection of compensator, Realization of basic compensators –Design of Lead and Lag Compensators **UNIT IV** **[Text Book - 2]** **State Space Analysis:** Concepts of state, state variables, State Model; State space equations, development of state models for Electrical, mechanical and electromechanical systems, State Space representation using Phase Variables, Decomposition of Transfer Functions, Diagonalization, solution of state equation, the state transition matrix and its properties, computation of STM by Laplace Transformation, Canonical Transformation, transfer function from state model, Eigen values and Eigenvectors ,Stability of a system by its State model, State Controllability and Observability of linear systems.
Text books and Reference books	**Text Book(s):** [1] I.J.Nagrath & M.Gopal , " Control Systems Engineering ", 5th ed., New Age publisher. [2] A.Ananda Kumar, "Control Systems", 2nd ed., PHI, 2014. **Reference Books:** [1].K.Ogata , "Modern Control Engineering", 5th ed., PHI publishers, 2010. [2].B.C.Kuo, "Automatic Control Systems with MATLAB programming", 7th ed., PHI publishers. [3] Schaum's Series , "Feedback and control systems", 2nd ed., Tata Mc Graw Hill Ltd.
E-resources and other digital material	[1] www.nptel.ac.in/courses/108101037/ [2] www.dis.uniroma1.it/~lanai/controlsystems/cs_lectures_enhtml

14EE3502/14EI3502 –INTEGRATED CIRCUITS & APPLICATIONS

Course Category:	Programme core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3- 1 - 0
Prerequisites:	Electronic Circuits–I (14EE3302), Electronic Circuits–II (14EE3402), Network Analysis-I (14EE3303)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	**Analyze** various characteristics of op-amp and design different linear op-amp circuits.
	CO2	**Analyze** and design different nonlinear op-amp circuits and waveform generators.
	CO3	**Understand** the concepts of various DACs and ADCs and design active filters suitable for various applications.
	CO4	**Design** 555 Timer circuits,565PLL and μA723 voltage regulators based on applications.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	L	M		H								
	CO2		H		H								
	CO3		M		H								
	CO4	L	M										

Course Content

UNIT-I **[Text Book-1,2]**

Operational Amplifiers:

Block diagram of Operational Amplifier, Integrated circuits-types, classification; Ideal Op-amp, 741 op-amp & its features and specifications, DC characteristics of Op-Amp, Op-Amp parameters & Measurement and compensation of Input & Output Offset voltages & currents, AC characteristics of Op-Amp, Frequency response, stability Frequency compensation and Slew rate.

Linear Applications of OP-Amps:

Negative feedback concept in Op-Amps, Inverting and non-inverting amplifier, Voltage follower, Differential amplifier, common mode and differential mode of operation. The summing Amplifier, Instrumentation amplifier, AC amplifier, V-I, I-V converters, Integrator and Differentiator.

UNIT-II **[Text Book-1,2]**

Non Linear Applications of OP-Amps:

	Sample and Hold circuit, Log and antilog amplifiers, Precision diode, Applications- half-wave precision rectifier, full-wave precision rectifier, Peak value detector, clipper, clamper, Absolute value output circuit. **Comparators and Wave Form Generators:** Introduction to comparator, Basic comparator, comparator characteristics, Limitations of Op-Amps as comparators, Applications: zero-crossing detector, window detector, voltage limiters; Waveform generators- Oscillators, Schmitt Trigger, Square-wave Generator, Triangular wave Generator, saw tooth wave Generator. **UNIT-III** **[Text Book-1,2]** **Active Filters:** Active LP and HP filters, Sallen key LP and HP filters, Band pass filters – Wideband, Band pass and multiple feedback Band pass filters; Band stop filters, state variable filters, All pass filters. **D/A and A/D Converters:** Introduction, Basic DAC techniques - weighted resistor DAC, R-2R Ladder D/A converter; A/D conversion–parallel comparator type ADC, Counter type ADC, Tracking A/D converters, successive approximation ADC and Dual slope ADC,DAC and ADC Specifications. **UNIT-IV** **[Text Book-1,2]** **Applications of Special ICS:** The 555 timer- 555 as Mono-stable and Astable Multivibrator and applications; voltage controlled oscillator; Phase Locked loops- operating principles, Monolithic PLLs, 565 PLL Applications; IC Voltage Regulators.
Text books and Reference books	**Text Book(s):** [1] Roy and Chowdhary, "Linear Integrated Circuits", 4th Edn., New Age International,2003 [2] Rama Kant A. Gayakwad, "Op-Amps and Linear Integrated Circuits",3rd ed., PHI, 1997 **Reference Books:** [1] Jacob, "Applications and Design with Analog Integrated Circuits", 2nd Edn., PHI, 1996 [2] Denton J Dailey, "Operational Amplifiers and Linear Integrated Circuits: Theory and Applications", Mc Graw Hill Ltd, 1989.
E-resources and other digital material	[1] www.analog.com [2] www.nptel.ac.in/video.php?subjectId=108106068 [3] www.linkwitzlab.com/filters.htm [4] www.allaboutcircuits.com.

14EE3503– MICROCONTROLLERS AND DIGITAL SIGNAL PROCESSORS

Course Category:	Programme core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Digital Circuits and Systems (14EE3306)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes		Upon successful completion of the course, the student will be able to:
	CO1	**Understand** architecture and instruction set of 8051 Microcontroller
	CO2	**Develop** code in embedded programming and interface various on-chip peripherals of 8051 Microcontroller
	CO3	**Program** and Interface the various external peripherals to 8051Microcontroller
	CO4	**Understand** the architecture of Digital signal processor TMS320F/C28XX

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		H					M			L		
CO2	L	M					M					
CO3	L	M					M					
CO4		H					M			L		

Course Content

UNIT-I **[Text Book-1,2]**

Introduction to Embedded Technology:

Microprocessor, Microcontroller and General Comparison of Microcontroller with Microprocessor, Overview of 8051 family.

8051 Microcontroller Hardware:

Features of 8051, Architecture - On chip registers and special function registers, memory organization. Pin description - input/output pins, ports circuits and functioning.

Instruction Set of 8051:

Addressing Modes, Data Moving, Arithmetic and Logical Instructions, Jump and Call Instruction. Assembler directives.

UNIT–II **[Text Book-1,2]**

8051 Assembly Language Programming :

Assembly language development tools **, s**imple arithmetic and logical programming, I/O port programming,

8051 On-chip Peripherals Interfacing:

Timers - operation, registers, modes of operation, baud rate generation and timer programming.

Serial port (UART) - Classification of serial communication, serial data transfer/receive

	and control operation using SCON and SBUF registers, modes of operation of serial port and programming. Interrupts: Classification, priority, enabling/disabling of interrupts and programming. **UNIT–III** **[Text Book-1,2]** **8051 External Peripherals Interfacing:** Data conversation device Interfacing: ADC-0808, DAC-0800, and programming. Interfacing of LED, Seven segment display, LCD, keyboard, stepper motor and sensors to 8051. **UNIT–IV** **[Text Book-3]** **Basics of Digital Signal Processors:** Basic architecture of TMS320F/C28XX, memory mapping and addressing modes, Key instruction set of TMS320F/C28XX, number format, peripherals, simple programming.
Text books and Reference books	**Text Book(s):** [1] Ayala, Kenneth J., 'The 8051 Microcontroller Architecture, Programming and Applications', Penram International. [2] M.A.Mazidi, J.G.Mazidi, R.D.Mc Kinlay, 'The 8051 Microcontroller and Embedded Systems using Assembly and C', Pearson Education. [3] TMS 320F/C28XX users guide. **Reference Books:** [1] Subrata Ghoshal, '8051 Microcontroller: Internals, Instructions, Programming and Interfacing', Pearson Education. [2] A.V.Deshmukh, "Microcontrollers Theory and Applications", Tata McGraw Hill. [3] B. Venkataramani, M. Bhaskar, Digital signal processors Architecture, programming and applications, TMH publications
E-resources and other digital material	www.ti.com/lit/ug/spru307a/spru307a.pdf

14EE3504 – SYNCHRONOUS & SPECIAL MACHINES

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	DC Machines(14EE3305), Transformers and Induction Motors (14EE3405), EMF Theory(14EE3404)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	**Understand** the constructional & operational features of synchronous machines
	CO2	**Analyze** the winding factors, induced emf, factors effecting the regulation and regulation methods of synchronous generators
	CO3	**Analyze** parallel operation of alternators
	CO4	**Illustrate** the starting methods of synchronous motors & **analyze** the behavior of synchronous motors

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M	H		H		H			M		
CO2	M	H			M		H					
CO3	H	H			H		H					
CO4	M	H			H		H					

Course Content

UNIT I **[Text Book-1]**

Synchronous Generators:

Construction, Different Excitation Methods, EMF equation with sinusoidal flux, winding factors, harmonics in generated voltage and their suppression, armature leakage flux, armature reaction, synchronous impedance, vector diagram, load characteristics, methods of determining regulation – direct load, EMF, MMF, ZPF and ASA, losses and efficiency.

UNIT II **[Text Book-1]**

Analysis of Salient Pole Machine:

Blondel's two reaction method for salient pole machine, phasor diagram, slip test, regulation of salient pole machines.

Parallel Operation:

Conditions**,** Synchronizing with infinite bus bars, synchronizing current, synchronizing power, expression for power, power angle characteristics, short circuit on 3-phase alternator, effect of variation of excitation and mechanical input on parallel operation, load sharing

	UNIT III **[Text Book-1]** **Synchronous Motors:** Theory of operation, starting methods, phasor diagrams, variation of current and power factor with excitation - minimum and maximum power for a given excitation and power circles (Qualitative treatment), V and inverted V curves, hunting – its prevention, synchronous condenser and its application. **UNIT – IV** **[Text Book-1]** **Special Machines:** Principle of operation, characteristics and applications of reluctance motor, hysteresis motor, AC series motors Stepper motors -Permanent magnet stepper motor, Variable reluctance stepper motor and hybrid stepper motor, static & dynamic characteristics of stepper motor and their applications.
Text books and Reference books	**Text Book(s):** [1] J B Gupta , "Theory & Performance Of Electrical Machines" S. K. Kataria & Sons, 01-Jan-2009. [2] D.P.Nagarath & I.J.Kothari , "Electric Machines" ,7th ed., TMH, 2005 **Reference Books:** [1] A.E.Langsdorf , "Theory of A.C Machines by", TMH [2] P.S.Bimbra , "Electrical Machines ", Khanna Publishers [3] A.E.Fitzerald,Charles Kingsley,Jr."Electric Machinery" Tata Mc. Graw Hill Education Pvt. Ltd, New Delhi , 6th ed., 2009.
E-resources and other digital material	http://nptel.ac.in/courses/108102046/#

Institutional Elective

1. 14EE2505/1-GENERATION AND UTILIZATION OF ENERGY

2. 14EE2505/2 - ENERGY AUDIT

3. 14EE2505/3- RENEWABLE ENERGY SYSTEMS

4. 14EE2505/4 – SOLAR PHOTOVOLTAICS

14EE2505/1 – GENERATION AND UTILIZATION OF ENERGY

Course Category:	Institutional Elective	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 0 - 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	**Understand** the concepts of Non Conventional and Conventional Sources of Energy
	CO2	**Understand** the concepts of Economics of generation
	CO3	**Understand** the concepts of Electric Heating and Welding
	CO4	**Understand** the concepts of Illumination Engineering

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)(L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M							M	L			
	CO2	M				M							
	CO3	M				M				L			
	CO4	M				M				L			

Course Content

UNIT–I **[Text Book-1]**

Non Conventional and Conventional Sources of Energy:

Introduction, Principles of Wind power, Geothermal Power, Solar energy, Hydro station, Steam power Plant, Nuclear Power plants, and the gas turbine plants**.**

UNIT–II **[Text Book-1]**

Economics of Generation:

Introduction, Definitions, Load duration curve, Number in size of generation units , Cost of Electrical Energy, Tariff or charge to consumer (elementary treatment only)

UNIT–III **[Text Book-1]**

Electric heating and Welding:

Introduction , Methods of Electric heating, Requirements of a good heating material, Design of heating element, Temperature control of resistance furnace , Electrical arc furnace , Induction heating, Dielectric heating ,Electrical welding, Resistance welding, Electrical arc welding.

	UNIT-IV **[Text Book-1]** **Illumination Engineering:** Introduction , The nature of radiation, definitions , polar curve, Law of Illumination, Luminous efficacy, Photometer , Lumen or flux method of calculations, The electric lamp flood lighting and calculations, Street lighting and Design of choke and capacitor**.**
Text books or Reference books	**Text Book(s):** [1] C. L. Wadhwa, "Generation, Distribution and Utilization of Electrical energy", Revised ed.,New Age International Pvt.Ltd Publishers, 2005. **Reference Books:** [1] S.Sivanagaraju, M.Bala Subba Reddy and D.Srilatha, " Generation and Utilization of Electrical Energy ", Pearson Publisher, 2010.
E-resources and other digital material	[1] http://nptel.ac.in/video.php?subjectId=108102047 [2] http://nptel.ac.in/courses/108105058/

14EE2505/2 – ENERGY AUDIT

Course Category:	Institutional Elective	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 0 - 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	**Understand** the concepts of energy audit, instruments
	CO2	**Analyze** depreciation methods.
	CO3	**Analyze** energy efficient transformers & motors
	CO4	**Analyze** distribution systems & energy efficient lighting systems

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H			H	H	L				L		
CO2	H			H	H	L				L		
CO3	H			H	H	L				L		
CO4	H			H	H	L				L		

Course Content

UNIT-I **[Text Book-1]**

Energy Audit:

Definitions-Need-concepts-Types of energy audit; Energy index – cost index – pie charts – Sankey diagrams.

UNIT-II **[Text Book-2]**

Energy Economics:

Introduction-Cost benefit risk analysis-Payback period-Straight line depreciation-Sinking fund depreciation—Reducing balance depreciation-Net present value method-Internal rate of return method-Profitability index for benefit cost ratio.

UNIT-III **[Text Book-2]**

Transformer –losses & efficiency, energy efficient transformers, simple problems, assessment of Transmission & distribution losses, simple problems Electric motors-Different motors, motor efficiency & losses, field test to determine efficiency, simple problems.

UNIT-IV **[Text Book-2]**

Power factor improvement and benefits, selection and location of capacitors, simple problems, Types of tariff, simple problems and Lighting-Energy efficient light sources-Energy conservation in Lighting **.**

Text books and Reference books	**Text Book(s):** [1] Wayne C.Turner, "Energy management Hand book", 8th ed., John wiley and sons. [2] S.C. Tripathy, Electric "Energy Utilization and Conservation", Tata McGraw Hill, 1991. **Reference Books:** [1] John C. Andreas, "Energy efficient electric motors selection and application". [2] Amit kumar Tyagi, "Hand book on Energy Audit and Management", TERI(Tata energy research Institute). [3] Paul W.O. Callaghan, "Energy Management", McGraw hill Book Company. [4] Rakosh Das Begamudre, "Energy conversion systems", xth ed., new age international publishers. [5] W.R.Murphy & G.Mckey Butterworths, "Energy Management", new age international publishers). [6] Kurose and Ross, "*Computer Networks – A Top-down Approach Featuring the Internet",* 'Pearson Education.
E-Resources and other digital material	[1] **BEE Reference book: no.1/3/4.** www.bee-india.com

14EE2505/3 RENEWABLE ENERGY SYSTEMS

Course Category:	Institutional Elective	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 0 - 0
Prerequisites:	Environmental Studies	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	**Understand** the concepts of Solar Energy											
	CO2	**Understand** the concepts of Wind Energy											
	CO3	**Understand** the concepts of Bio-Energy											
	CO4	**Understand** the concepts OTEC, Tidal, Geothermal and Hydro											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M					M		M				
	CO2	M					M		M				
	CO3	M					M		M				
	CO4	M					M		M				

Course Content

UNIT – I **[Text Book-1,2]**

Solar Energy:

Solar Radiation – Measurements of solar Radiation and sunshine – Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion – Solar Cells – PV Systems – Solar PV Applications - Solar PV Power generation schemes.

UNIT – II **[Text Book-1]**

Wind Energy:

Energy available from wind, General formula, Lift and drag – Wind Energy Conversion Systems – Horizontal axis and Vertical axis rotors, Determination of torque coefficient, Wind Energy generators and its performance – Wind Energy Storage – Applications – Hybrid (WIND & SOLAR) systems.

UNIT – III **[Text Book-1]**

Bio-Energy:

Biomass, Biogas, Source, Composition, Technology for utilization – Biomass direct combustion – Biomass gasifier - pyrolysis and liquefaction – Biogas plant - biochemical conversion: anaerobic digestion, alcohol production from biomass - chemical conversion process: hydrolysis and hydrogenation – Digesters – Ethanol production – Bio diesel

	production and economics. **UNIT-IV** **[Text Book-1]** **OTEC, Tidal, Geothermal and Hydro:** Tidal energy – Wave energy – Data, Technology options – Open and closed OTEC Cycles – Small hydro, turbines – Geothermal energy sources, power plant and environmental issues. **New Energy Sources:** Hydrogen, generation, storage, transport and utilization, Applications: power generation, transport – Fuel cells – technologies, types – economics and the power generation
Text books and Reference books	**Text Book(s):** [1] G.D. Rai, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 1999 [2] S.P. Sukhatme, "Solar Energy" , Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997. **Reference Books:** [1] Godfrey Boyle, "Renewable Energy- Power for a Sustainable Future", Oxford University Press, U.K., 1996. [2] Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 1986. [3] G.N. Tiwari, "Solar Energy – Fundamentals Design, Modelling and applications", Narosa Publishing House, New Delhi, 2002. [4] L.L. Freris, "Wind Energy Conversion systems", Prentice Hall, UK, 1999
E-Resources and other digital material	

14EE2505/4 SOLAR PHOTOVOLTAICS

Course Category:	Institutional Elective	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 0 - 0
Prerequisites:	Basic Electrical Engineering(14EE1205), Basic Electronics(14EC1206), Environmental Studies(14EN1306)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Understand the Concepts of Solar Cell
	CO2	Understand the Solar Cell Characteristics
	CO3	Understand the concept of Solar Radiation and photovoltaic modules
	CO4	Design concepts of Solar Photo Voltaic Systems

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	L			M		L	M			
CO2	H	L	L			M		L	M			
CO3	H	L	L			M		L	M			
CO4	H	L	L			M		L	M			

Course Content

UNIT I [**Text Book-1**]

Introduction to Solar Cells:

PN junction diode, PN junction equilibrium condition-Space charge region, Energy band diagram of PN junction, PN junction potential ,Width of depletion region. Carrier Movements and current densities. PN junction under illumination-Generation of photo voltage, light generated current, Types of Solar Cells.

UNIT II **[Text book -1]**

Solar Cell Characteristics and Performance:

Solar cell characteristics - I-V relation of solar cells, P-V Characteristics. Limits of cell parameters-short circuit current, open circuit voltage, Maximum Voltage, Current Maximum, Power Maximum, Fill factor, Efficiency, losses in Solar cells – Simple Calculation in Efficiency of Solar Cell.

Unit III **[Text book -1]**

Solar Radiation and photovoltaic modules:

Sun and earth movement- Declination angle, apparent motion of the sun and solar altitude. Angle of Sun rays on Solar Collector; **sun Tracking,** Solar PV modules from Solar Cells, Series connection, Parallel connection –Mismatch in Series and Parallel Connections,

	Feedback diode, PV module power output. **Unit IV** **[Text book -1]** **Solar Photo Voltaic System Design and Applications:** Introduction to solar PV systems, Standalone PV system configuration, Standalone System with battery and AC (or) DC load, Grid connected PV systems Configuration - Working of a Grid Connected System. Example-single stage grid connected- Simple Problems related to Design of Standalone PV system and Grid connected PV systems
Text books and Reference books	**Text Book(s):** [1] Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications'', 2nd ed., PHI, 2011. **Reference books:** [1] B.H.Khan, " Non Conventional Energy Resources",2nd ed.,McGraw Hill Education private limited,New Delhi,year 2009.
E-Resources and other digital material	www.nptel.ac.in Prof.S. Benerjee , "Solar PhotoVoltaics" Dept of Electrical Engineering I.I.T,Kharagpur

INDEPENDENT LEARNING

14EE5506A - ILLUMINATION ENGINEERING

Course Category:	Independent Learning	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Acquire Knowledge on illumination.
	CO2	Acquire Knowledge on various light sources.
	CO3	Ability to apply the Knowledge of illumination to the design of interior and exterior lighting.
	CO4	Understand the Knowledge about the measurements and protections.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	L		H			L	M			
CO2	H	L	L		H			L	M			
CO3	H	L	L		H			L	M			
CO4	H	L	L		H			L	M			

Course Content

UNIT–I **[Text Book-1]**

Introduction

Radiation, color, eye and vision; different entities of illuminating systems; Light sources; day light, incandescent, electric discharge, fluorescent, arc lamps and Lasers..

UNIT–II **[Text Book-1]**

Illumination Sources:

Luminaries, wiring Switching and control circuits, Law of illumination; illumination from point, line and surface sources, Photometry and spectrophotometry; photocells, Environment and glare, General illumination and design.

UNIT–III **[Text Book-2]**

Lighting Applications

Interior lighting- industrial, residential, office departmental stores, indoor stadium, theater and hospitals.

Exterior Lighting-flood, street, aviation and transport lighting, lighting for displays and signaling – neon signs, LED-LCD displays beacons and lighting for surveillance.

UNIT–IV **[Text Book-3]**

	Measurement and Protections Utility services for Large building/office complex and layout of different meters and protection units. Different type of loads and their individual protections. Selection of cable/wire sizes; potential sources of fire hazards and precautions. Emergency supply-standby and UPS. a specific design problem on this aspect.
Text books and Reference books	**Text Book(s):** [1] Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to the Laser", 2nd Edition, Visions Comm., 1994. [2] Ronald N. helms, M. Clay Beicher, "Lighting for Energy efficient Luminous Environments", Prentice Hall,1991. [3] Jack L. Lindsey, " Applied illumination Engineering" The Fairmont Press Inc., 1991 **References Books:** [1] Marc Schiler, " Simplified Design of Building Lighting" John Wiley and Sons, 1992. [2] IES Lighting Handbook, 8th Edition, 1993
E-resources and other digital material	[1] http://www.nptel.ac.in Prof N.K.Kishore, " Illumination Engineering (web Course)", IIT Kharagpur.

14EE5506B – POWER ELECTRONICS AND DISTRIBUTED GENERATION

Course Category:	Independent Learning	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Understand the Concepts in distribution systems.
	CO2	Understand the Behavior of Intentional and unintentional islanding,
	CO3	Understand the Concepts of Selection of power converter components.
	CO4	Understand the Concepts of Power quality, and recent trends in power electronic DG interconnection.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		L		L				M		M	
CO2	H		L		L						M	
CO3	H		L		L						M	
CO4	H		L		L				M		M	

Course Content

UNIT–I **[Text Book-1,2]**

Introduction to Distributed Generation

Distributed Generation (DG) - Overview and technology trends. Introduction to distribution systems. Radial distribution system protection: Fuse, circuit breakers, reclosers, sectionalizers. Per-unit analysis, fault analysis, sequence component analysis, sequence models of distribution system components. Implications of DG on distribution system protection coordination. Power quality requirements and source switching using SCR based static switches.

UNIT–II **[Text Book-1,2]**

Relaying and Protection

Distribution system loading, line drop model, series voltage regulators and on line tap changers. Loop and secondary network distribution grids and impact of DG operation. Relaying and protection, distributed generation interconnection relaying, sensing using CTs and PTs. Intentional and unintentional islanding of distribution systems. Passive and active detection of unintentional islands, non detection zones. DG planning, cost implications of power quality, cost of energy and net present value calculations and implications on power converter design.

	UNIT–III **[Text Book-2]** **Power converter topologies** Power converter topologies and model and specifications for DG applications. Capacitor selection, choice of DC bus voltage, current ripple, capacitor aging and lifetime calculations. Switching versus average model of the power converter and EMI considerations in DG applications. Semiconductor device selection, device aging due to thermal cycling, and lifetime calculations. **UNIT–IV** **[Text Book-1,2]** **Power quality issues** Issues in output ac filter design, filter inductor selection. Insulation aging issues. Packaging issues in the power converter. Calculation of damage due to thermal cycles. Thermal impedance models. Control of DG inverters, phase locked loops, current control and DC voltage control for stand alone and grid parallel operations. Protection of the converter. Complex transfer functions, VSI admittance model in DG applications. Power quality implication, acceptable ranges of voltage and frequency, flicker, reactive power compensation, and active filtering and low voltage ride through requirements.
Text books and Reference books	**Text Book(s):** [4] Technical literature – papers published in power electronics related journals and IEEE standards. [5] Arthur R. Bergen, Vijay Vittal, Power Systems Analysis, Prentice Hall, 1999. **References Books:** [3] Ned Mohan, Tore M. Undeland, William P. Robbins, Power Electronics: Converters, Applications, and Design; Wiley, 2002.
E-resources and other digital material	[2] http://www.nptel.ac.in/courses/108108034/ Dr. Vinod John," Power Electronics and Distributed Generation" Department of Electrical Engineering IISc Bangalore, India.

14EE3507 – POWER SYSTEMS-I

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Network Analysis I(14EE3303) & Network Analysis II(14EE3403)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	**Understand** the concepts of economic power generation
	CO2	**Elucidate** conventional generating plants
	CO3	**Describe** the electrical substations and grounding
	CO4	**Analyze** AC and DC distribution systems

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M				H		H	M				
CO2			H				H	M		L		
CO3					H		H					
CO4	M				H		H					

Course Content

UNIT I **[Text Book-1]**

Economical Aspects:

Economics of generation, factors affecting cost of generation, choice of generation, size of generator units. Significance of Load curve- load duration curve -load factor— diversity factor – plant use factor - reduction of cost by inter connected stations.

Economics of power generation:

Cost of electrical energy-expression for cost of electrical energy-methods of determining Depreciation.

Power factor considerations :

Causes of low power factor – methods of improving power factor – phase advancing and generation of reactive kVAr – most economical power factor for constant kW load and constant kVA type loads.

Tariff:

Objectives and characteristics of Tariff – types of Tariff.

UNIT II **[Text Book-1]**

Thermal power stations:

Selection of site for thermal station – layout and salient features.

Hydroelectric Stations:

Hydrology – hydrographs – mass curves – classification of hydroelectric plants - general arrangement and operation of hydroelectric plants and its function.

Nuclear Power Stations:

	Introduction to nuclear physics-Nuclear reactions-feasibility of nuclear power station-main parts of reactors and their functions-types of reactors-BWR, PWR and CANDU reactors. **Gas Power Stations:** Simple gas turbine plant-methods to improve thermal efficiency. **UNIT III** **[Text Book-1&2]** **Substations:** Classification of substations: Air insulated substations - Indoor & Outdoor substations Sub-stations layout – location & description of all the substation equipment. **Bus bar arrangements**: Single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams. **Grounding:** Ungrounded neutral systems-other methods of non effective grounding-grounding practices-tolerable limits of body currents, soil resistivity and earth resistance. **UNIT IV** **[Text Book-1&2]** **A.C & D.C. Distribution Systems:** Introduction and Classification of Distribution Systems. **D.C. Distribution Systems**: Voltage Drop Calculations (Numerical Problems) in D.C Distributors for the following cases: Radial D.C Distributor fed at one end and at both the ends (equal/unequal Voltages, uniformly distributed loads and concentrated loads) and Ring Main Distributor. **A.C. Distribution Systems:** Voltage Drop Calculations (Numerical Problems) in A.C. Distributors for the following cases: Power Factors referred to receiving end voltage and with respect to load voltages.(only for concentrated loads).
Text books and Reference books	**Text Book(s):** [1] M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A.Chakraborti, "Power System Engineering", Dhanpat Rai & Co. Pvt. Ltd. [2] V.K Mehta and Rohit Mehta, "Principles of Power Systems" S.Chand & Company Ltd., New Delhi. **Reference Books:** [1] S.N.Singh , "Electrical Power Generation, Transmission and Distribution", PHI, 2003. [4] C.L.Wadhwa, "Electrical Power systems ", New Age international Publishers
E-resources and other digital material	

14EE3551 - AC MACHINES LABORATORY

Course Category:	**Programme core**	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 0 – 3
Prerequisites:	Transformers and Induction Machines(14EE3405) Synchronous and Special machines (14EE3504)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:											
	CO1	Design and conduct experiment.										
	CO2	Analyze and present experimental results.										
	CO3	Exhibit professional behavior										
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1		H	L	H								
	CO2				H			H					
	CO3				H			H					

Course Content

List of Experiments

1. Load test on alternator
2. Regulation of alternator by synchronous impedance & mmf methods
3. Regulation of alternator by ZPF method
4. Measurement of X_d and X_q of a 3 - phase alternator
5. Synchronization of alternator with infinite bus
6. Parallel operation of two synchronous machines
7. V and inverted V curves of synchronous motor
8. Synchronous motor performance i) With constant excitation ii) With constant load
9. Separation of core losses in single-phase transformer
10. Separation of losses in 3-phase induction motor
11. Load test on Induction generator
12. Harmonics analysis of transformer
13. Parallel operation of two-3phase transformers
14. Load test on Universal motor
15. Simulation of ac machines by SIMULINK
16. Effect of harmonics on ac motor using simulation

NOTE: In all laboratories a minimum of 10 experiments are to be completed.

14EE3552 – ELECTRONICS & WORKSHOP LAB-II

Course Category:	Program core	**Credits:**	2
Course Type:	**Practical**	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Analyze various characteristics of op-amp and design different linear and non-linear op-amp circuits and Waveform generators.											
	CO2	Design active filter circuits suitable for particular application.											
	CO3	Design 555 Timer circuits and voltage regulators.											
	CO4	Design DAC using IC 741											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	L	M		H								
	CO2				H								
	CO3				H								

Course Content

LIST OF EXPERIMENTS

Electronics Laboratory

1. Measurement of Op-amp parameters
2. Applications of Op-amp -Adder, subtractor, comparator
3. Realization of Integrator & differentiator using opamp
4. Realization of Instrumentation amplifier using opamp
5. Waveform generation using opamp (square, triangular)
6. Design of Clipper and Clamper circuits using opamp
7. Wein bridge Oscillator using opamp
8. Design of active filters using opamp (LPF & HPF-first order)
9. IC 555 Timer Monostable operation circuit
10. IC 555 Timer Astable operation circuit
11. Schmitt trigger using IC 555 Timer
12. IC 565 PLL Applications
13. Three terminal Voltage regulators IC 7805
14. Design of IC Regulator using 723
15. D/A converter(R-2R ladder)

Note: - Realizing all the above experiments using different types of ICs

	Workshop Laboratory: 1. Design and Fabrication of low rated transformers upto 500VA 2. PCB Fabrication 3. Trouble shooting of Relays 4. Trouble shooting of Heater , Electric iron and Fans 5. To Study DC motor starters 6. To Study AC motor starters 7. Trouble shooting of induction motor
Text books and Reference books	**Text Book(s):** [1] Roy and Chowdhary, "Principles of Integrated Circuits", 2nd Edn., New Age International, 2003. [2] Rama Kant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 3rd Ed., PHI, 1997.
E-resources and other digital material	www.allaboutcircuits.com.

NOTE: In all laboratories a minimum of 10 experiments are to be completed.

14EE3601 FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING

Course Category:	**Programme core**	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 1 - 0
Prerequisites:	Complex Analysis and Numerical Methods(14MA1301)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	**Identify** and **Categorize** discrete time systems.											
	CO2	**Analyze** discrete systems using Z transforms.											
	CO3	**Apply** DFT to discrete systems and evaluate DFT using Fast Fourier and Transforms.											
	CO4	**Design** FIR and IIR filters and Realize digital filters..											
Contribution of Course Outcomes towards achievement of Program Outcomes (M-Medium, H–High,L-Low)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H				H		H					
	CO2	H						H					
	CO3	H				H		H					
	CO4	H				H		H					

Course Content

UNIT I **[Text Book - 1]**

Discrete Signals and Systems:

Introduction to digital signal processing, Advantages and applications, Discrete time signals, LTI system: Stability and causality, Frequency domain representation of discrete time signals and systems

Z-Transforms:

Z-transforms, Region of convergence, Z-transform theorems and properties, Relation between Z-transform and Fourier transform of a sequence, Inverse Z-transform using Cauchy's integration theorem, Partial fraction method, Long division method, Solution of difference equations using one sided Z-transform, Frequency response of a stable system.

UNIT II **[Text Book - 2]**

DFT and FFT:

Discrete Fourier Series, Properties of DFS, Discrete Fourier Transform, Properties of DFT, Linear convolution using DFT, Computations for evaluating DFT, Decimation in time FFT algorithms, Decimation in frequency FFT algorithm, Computation of inverse DFT.

UNIT III **[Text Book - 2]**

IIR Filter Design Techniques:

Introduction, Properties of IIR filters, IIR filter design using bilinear transformation and impulse Invariance methods; Design of Digital Butterworth and Chebyshev filters using bilinear transformation, Impulse invariance transformation methods. Design of digital filters using frequency transformation method.

	UNIT – IV **[Text Book - 2]** **FIR Filter Design Techniques:** Introduction to characteristics of linear phase FIR filters, Frequency response, Designing FIR filters using windowing methods: Rectangular window, Hanning window, Hamming window, Generalized Hamming window, Bartlett triangular window, Comparison of IIR and FIR filters. **Realization of Digital Filters:** Direct, Canonic, Cascade, Transposed, Parallel and Ladder realizations
Text books and Reference books	**Text Book:** [1] Alan V Oppenheim and Ronald W Schafer, "Digital Signal Processing, Pearson Education", PHI, 2004 (UNIT-I) [2] Proakis, J. Gard and D. G. Manolakis, "Digital Signal Processing : Principals Algorithms and applications" , 3rd ed., PHI, 2003 (Unit-II, III, IV) **Reference Books:** [1] M.H.Hayes, "Digital Signal Processing", TMH [2] P.Ramesh Babu, "Digital Signal Processing", 2nd ed., Scitech Publications, 2004. [3] S K Mitra, "Digital Signal Processing: A Computer Based Approach", 2nd ., ed., TMH, 2003 [4] S.Salivahanan ,"Digital Signal Processing", TMH,2000.
E-resources and other digital material	[1] www.dsptutor.freeuk.com [2] https://nptel.iitm.ac.in/courses/Webcourse contents/ IITKANPUR/ Digi_Sign_Pro/ ui/ About-Faculty.html

14EE3602 – POWER ELECTRONICS

Course Category:	**Programme core**	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 1 - 0
Prerequisites:	Electronics Devices & Circuits (14EE3302), Network Analysis- I (14EE3303), Network Analysis- II (14EE3403).	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	**Understand** the theory of various power electronic devices.											
	CO2	**Analyze** the operation of phase controlled converters.											
	CO3	**Elucidate** the operation of various DC & AC choppers.											
	CO4	**Analyze** the operation of various Inverters.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	H			M		M					
	CO2	H	H			H		H				H	
	CO3	H	H			H		H					
	CO4	H	H			H		H					

Course Content

UNIT I **[Text book-1]**

Power Semiconductor Devices:

Silicon Controlled Rectifier(SCR) -Basic theory of operation of SCR -Static characteristics – Two transistor analogy - Turn on and turn off methods - SCR firing circuits (UJT Firing circuit)- Dynamic characteristics of SCR -Series and parallel connections of SCR's – Protection Techniques-Ratings of an SCR –Numerical problems-Characteristics of uncontrolled & fully controlled switches (Power diode, BJT, MOSFET, IGBT), gate driving circuits for MOSFET/IGBT).

UNIT II **[Text book -1]**

Phase Controlled Rectifiers:

Introduction - Performance parameters of converters - line Commutation - Principles of single - phase Half wave controlled Rectifier with R, RL, and RLE load without and with Freewheeling Diode -Numerical problems-Principles of single phase full wave and semi controlled midpoint & bridge converters with R, RL and RLE load without and with Freewheeling Diode - Effect of source inductance - Numerical problems, Three phase converters -Three pulse and six pulse converters with R, RL loads- Effect of source

	inductance- single phase Dual converters - Numerical Problems. **UNIT III:** **[Text book -1]** **Choppers:** ***DC Choppers****:* Introduction –Forced Commutation methods - Time ratio control and Current limit control strategies – chopper classification- Buck converter-Boost converter-Buck -Boost converter-minimization of ripple with volt-sec balance, Four quadrant Chopper operation. ***AC Choppers:*** AC voltage controllers – Single phase two SCRs in anti parallel– With R and RL loads– TRIAC ac voltage controller with R and RL loads – Derivation of RMS load voltage, current and power factor -Numerical problems. **UNIT – IV** **[Text book -1]** **Inverters:** Inverters –Classification of inverters (VSI & CSI) - single phase voltage source bridge inverters with R, RL and RLC loads- single phase current source inverters-comparison between VSI & CSI - Three phase VSI (180,120 Degree conduction modes) - Voltage control techniques for inverters Pulse width modulation techniques –Single pulse width modulation-Multiple pulse width modulation –sinusoidal PWM- comparison of PWM Techniques- Numerical problems.
Text books and Reference books	**Text Book:** [1] P.S.Bimbhra,"Power Electronics Circuits, Devices and Applications", Khanna Publishers [2] M. D. Singh & K. B. Kanchandhani , "Power Electronics", TMH, 1998. **Reference Books:** [1] Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics Converters, Applications, and Design," 3rd Edition, Wiley Publications. [2] M. H. Rashid , "Power Electronics: Circuits, Devices and Applications", 3rd ed., , Pearson publications [3] V.R.Murthy , "Power Electronics", 1st ed., Oxford University Press, 2005 [4] P.C.Sen, "Power Electronics", Tata Mc Graw-Hill Publishing.
E-resources and other digital material	www.nptel.ac.in/courses/108101038/

14EE3603 – ADVANCED CONTROL SYSTEMS

Course Category:	**Programme core**	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Linear Control Systems(14EE3501)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes		Upon successful completion of the course, the student will be able to:
	CO1	**Design** control systems using state feedback.
	CO2	**Analyz**e nonlinear control systems using describing function.
	CO3	**Determine** the stability of nonlinear systems using Lyapunov's method.
	CO4	**Explain** fuzzy set theory and design controllers using Fuzzy logic.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H						H					
CO2	H						H					
CO3	H						H					
CO4	H		H									

Course Content

UNIT-I **[Text Book-1]**

State Feedback Controllers And Observers:

Review of state space concepts, Controllability, Observability, State feedback controller design through Pole Assignment, State observers: Full order and Reduced order.

UNIT–II **[Text Book-1]**

Nonlinear Control Systems - Describing Function Analysis:

Introduction – Characteristics: frequency-amplitude dependence, jump resonance, sub-harmonic oscillations, self - excited oscillations or limit cycles; Common physical nonlinearities – relay, dead zone, saturation, friction, backlash, hysteresis; Describing Functions of nonlinearities, Describing Function analysis of nonlinear control systems.

UNIT–III **[Text Book-1]**

Lyapunov's Stability Theory:

State space description of continuous-time autonomous systems and the equilibrium state; Terminology of Lyapunov stability - Stable in the sense of Lyapunov, asymptotically stable, globally asymptotically stable; instability; sign definite functions. Lyapunov function and Lyapunov's theorems on stability and instability. Stability analysis of linear time - invariant continuous - time systems using Lyapunov's direct method; Stability analysis of nonlinear systems using Krasoviskii method.

	UNIT–IV **[Text Book-1]** **Fuzzy Control:** Introduction – model–based control (Vs) rule-based control, premise (antecedent) and conclusion (consequent) rules; Fuzzy quantification of knowledge- Basic of Fuzzy logic, Fuzzy sets, Fuzzy operations, Fuzzy relations. Fuzzy inference- Mamdani Fuzzy rules, Takagi- Sugeno Fuzzy rules. Designing a Fuzzy logic controller - step-by-step procedure for designing an air conditioner.
Text books and Reference books	**Text Books:** [1] I.J.Nagrath & M.Gopal, "Control Systems Engineering ", New Age Int.(P), 5th ,ed., **Reference Books:** [1] K.Ogata, " Modern Control engineering ", PHI, 5th ,ed., [2] M.Gopal, "Modern Control System Theory", New Age, 3rd ,ed., [3] Rajasekharan and Vijaya lakshmi Pai, "Neural Networks,Fuzzy Logic and Genetic Algorithms: Synthesis and applications", PHI
E-resources and other digital material	

14HS1604 ENGINEERING ECONOMICS AND FINANCE

Course Category:	Institutional core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Understand various forms of organizations and principles of management
	CO2	Understand the various aspects of business economics.
	CO3	Acquire knowledge on Human resources and Marketing functions
	CO4	Understand best alternatives for various investment decisions and different depreciation methods

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M											M
	CO2	M				H							M
	CO3	M											M
	CO4	M				H							M

Course Content

UNIT I **[Text Book-1,2]**

Forms of Business Organization:

Salient Features of Sole Proprietorship, Partnership, Joint Stock Company: Private Limited and Public Limited Companies, Co-operative Society and Public Sector.

Management:

Introduction to Management, Management an Art or Science, Functions of Management, Principles of Scientific Management, Henri Fayol's Principles of Management.

UNIT II **[Text Book-1,2]**

Introduction to Economics:

Introduction to Basic Economic Concepts, Utility Analysis: Marginal Utility and Total Utility, Law of Diminishing Marginal Utility, Law of Equi Marginal Utility, Demand Analysis: Theory of Demand: Demand Function, Factors Influencing Demand, Demand Schedule and Demand Curve, Shift in Demand, Elasticity of Demand: Elastic and Inelastic Demand, Types of Elasticity, Factors of Production, Production Function, Production with one variable input, Isoquants, Returns to Scale, Cost Function: Cost - Output Relationship in short run and long run, Relationship between AC and MC. Supply Analysis: Supply Schedule and Supply Curve, Factors Influencing Supply, Supply Function, Theory of firm: Price determination under equilibrium of firm, Perfect

	competition. **UNIT III** **[Text Book-1,2]** **Human Resource Management:** Meaning and difference between Personnel Management and Human Resource Management, Functions of Human Resource Management, Recruitment and Selection Process. **Marketing Management:** Concept of Selling And Marketing – Differences, Functions of Marketing, Product Life Cycle, Concept of Advertising, Sales Promotion, Types of Distribution Channels, Marketing Research, Break-Even Analysis - Problems. **UNIT – IV** **[Text Book-1,2]** **Financial Management:** Functions of Financial Management, Time value of money with cash flow diagrams, Calculation of Simple and Compound Interest -Present worth, Future worth, Annual Equivalent, Methods of Evaluating Alternatives under Present worth method, Future worth method, Annual Equivalent method for choice of decision making among alternative projects. **Production Management:** An Overview and significance of Production Management, Objectives, Scope of production management, Production cycle. Depreciation, Causes of depreciation, Factors influencing depreciation, common methods of Depreciation: Straight Line Method, Declining Balance Method, Sum of Year's Digits Method –Problems
Text books and Reference books	**Text Book:** [1] P.Premchand Babu and M.Madan Mohan," *Managerial Economics and Financial Analysis",* Himalaya publishing house, 2011 edition. [2] M. Mahajan, "*Industrial Engineering and Production Management",* 2nd ,ed., Dhanpat Rai Publications. **Reference Books:** [1] Theusen & Theusen, "*Engineering economy*". [2] Philip Kotler & Gary Armstrong "*Principles of Marketing*" ,pearson prentice Hall,New Delhi,2012 Edition. [3] B.B Mahapatro, *"Human Resource Management".*,New Age International ,2011. [4] IM Pandey, "*Financial Management*" Vikas Publications 11th Edition [5] R.Panneer selvam, *"Production and operations management",* PHI Learning pvt Ltd, New Delhi, 2012.
E-resources and other digital material	[1] www.tectime.com [2] www.exinfm.com [3] www.slideshare.net [4] www.economywatch.com

14EE3605 – POWER SYSTEMS-II

Course Category:	**Programme core**	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Power System-I(14EE3507), EMF Theory(14EE3404),	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	**Evaluate** transmission line parameters.
	CO2	**Analyze** the performance of transmission lines and Understand the travelling wave phenomena.
	CO3	**Understand** the concepts of corona, mechanical design of lines and overhead insulators.
	CO4	**Describe** underground cables and **Predict** most economical size of conductors.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)(L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	H			H		H					
	CO2	H	H			H		H					
	CO3	M	H			H		H	M				
	CO4	M	H			H		H					

Course Content

UNIT–I **[Text Book-1,2]**

Introduction:

Structure of electric power system - different operating voltages of generation, transmission and distribution – advantage of higher operating voltage for AC transmission

Transmission Line Parameters:

Expressions for inductance and capacitance of single phase and 3-phase lines of symmetrical and transposed configurations, concept of self GMD (GMR) and mutual GMD, double circuit lines and bundled conductors, effect of ground on capacitance, line charging kVAr calculations. Inductive interference.

UNIT–II **[Text Book-1,2]**

Transmission Line Theory:

Short, medium and long lines, regulation and efficiency, Pie, T and rigorous methods of solution, ABCD constants, sending and receiving end power equations and power circle diagrams, surge impedance loading, Ferranti effect.

Travelling Wave Phenomena :

Travelling waves on a Transmission line – Wave Equation – Reflection, Refraction, Behavior of Travelling waves at the line terminations – Bewley's Lattice Diagram.

	UNIT–III **[Text Book-1,2]** **Corona:** Definition, factors affecting corona, critical voltages and power loss, Radio interference due to Corona. **Mechanical Design:** Mechanical design, sag and stress in overhead conductors suspended at level supports and at different levels, effect of wind and ice on sag, use of sag templates and string charts, conductor vibration-dampers. **Insulators:** Types of insulators, voltage distribution in a string of suspension insulators, Grading of insulators - Failure of insulator and testing, arcing horns. **UNIT-IV** **[Text Book-1,2]** **Underground Cables:** Types of cables, laying of cables, insulation resistance, electric stress and capacitance of single core cable, use of inter sheath, capacitance grading, capacitance of three core belted type cable, stress in a three-core cable, sheath effects, currents in bonded sheaths, electrical equivalent of sheath circuit, thermal characteristics of cables. Comparison of copper efficiencies between DC, AC Single phase, 3-phase, 3-wire & 4-wire systems, choice of voltage and frequency, Kelvin's law for most economical cross section and most economical current density and its limitations.
Text books or Reference books	**Text Book:** [1] M.L.Soni, P.V.Gupta, U. S. Bhatnagar and A. Chakraborti,"Power System Engineering", Dhanpat Rai & Co. Pvt. Ltd., 2001. [2] C L Wadhwa, "Electrical Power Systems", New Age Int. 4th ,ed., **Reference Books:** [1] Sivanagaraju, S.Satyanarayana, "Electric power transmission and distribution", Pearson Education, 2009. [2] J.B. Gupta , "Transmission & Distribution of Electrical Power", S. K. Kataria & Sons. [3] W.D. Stevenson , "Elements of Power system analysis", TMH, 4th, ed., [4] Kothari & Nagrath, "Power System Engineering", TMH,2nd ,ed., 2008
E-resources and other digital material	[1] www.nptel.ac.in [2] ocw.mit.edu

14EE3651 - DSP LABORATORY

Course Category:	**Programme core**	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 0 – 3
Prerequisites:	Fundamentals Of Digital Signal Processing(14EE3601) Microcontrollers & Digital Signal Processors(14EE3503)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Design and conduct experiment.											
	CO2	Analyze and present experimental results.											
	CO3	Exhibit professional behavior											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1		M		H								
	CO2				H			H					
	CO3				H			M					

Course Content

List of Experiments: <u>Programming</u>

1. Evaluation of DFT of a 16 sample sequence using DIT algorithm.
2. Evaluation of IDFT of a 16 sample sequence using DIT algorithm
3. Evaluation of DFT of a 16 sample sequence using DIF algorithm
4. Evaluation of IDFT of a 16 sample sequence using DIF algorithm
5. Design of FIR filter using windowing methods
6. Design of digital Butterworth filter using bilinear transformation
7. Design of digital Chebyshev filter using bilinear transformation.
8. Design of digital Butterworth filter using impulse Invariance Transformation method
9. Design of digital Chebyshev filter using Impulse Invariance Transformation method.
10. Digital filters using frequency transformation method

<u>Digital Signal Processors:</u>

1. Program to perform Linear convolution using CC Studio
2. Program to perform Circular convolution using CC Studio
3. Program to perform FFT operation using CC Studio .
4. Program to perform Correlation using CC Studio
5. Implementation of FIR filters using Window Techniques
6. Sine Wave generation using lookup table output using DAC
7. Implementation of PI controller using Numerical methods
8. Design of Low Pass Filters

NOTE: In all laboratories a minimum of 10 experiments are to be completed.

14EE3652 - CONTROL SYSTEMS & MICROCONTROLLERS LABORATORY

Course Category:	Programme core	**Credits:**	2
Course Type:	**Practical**	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:	Linear Control Systems(14EE3501), Microcontrollers & Digital Signal Processors(14EE3503).	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Design and conduct experiment.											
	CO2	Analyze and present experimental results.											
	CO3	Exhibit professional behavior											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1		M		H								
	CO2				H			H					
	CO3				H			M					

Course Content

List of Experiments

1. Time response of second order system (MATLAB also)
2. Characteristics of synchros.
3. Effect of P, PI, PID controller on a second order system.
4. Lag and Lead compensation – Magnitude and phase plot.
5. Transfer function of D.C. generator.
6. Temperature controller using PID.
7. Characteristics of A.C. servo motor.
8. Stability studies for physical system using SIMULINK
9. Stability studies using Nyquist and Bode Plots using MATLAB
10. State Space Analysis using MATLAB

Microcontrollers Lab:

1. Finding sum of first 100 integers using 8051
2. Program to arrange the given series of data in ascending and descending order using 8051
3. Interfacing of keyboard using 8051
4. Interfacing of elevator program using 8051
5. Interfacing of stepper motor using 8051
6. Implementation of traffic signal control using 8051
7. Interfacing of ADC using 8051
8. Interfacing of DAC using 8051

NOTE: In all laboratories a minimum of 10 experiments are to be completed.

14EE3701 – UTILIZATION OF ELECTRICAL POWER

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture- Tutorial- Practice:**	3 -1 - 0
Prerequisites:	DC Machines(14EE3305) Transformers and Induction Motors(14EE3405) Basics of Electronics Engineering(14EC1205B)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Illustrate the concepts of electric traction & braking methods.
	CO2	Demonstrate the concepts of electric heating, welding and design of heating element.
	CO3	Explain the construction and working principle of different types of lights, designing of lightning system.
	CO4	Demonstrate the concepts of refrigeration and air- conditioning.

Contribution of Course Outcomes towards achievement of Program Outcomes (M-Medium, H–High,L-Low)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M				M		M					
	CO2	M		M		M		M					
	CO3	M		M		M		M	M				
	CO4	L				M		M	L				

Course Content

UNIT-I **[Text Book-1]**

Electric Traction:

Systems of electric traction - mechanics of train movement, speed-time curves, effect of speed, acceleration and distance on schedule, Power and energy output from driving axles, specific energy output, series – parallel method of speed control, transition methods, collectors, different types of electric braking, plugging, rheostatic and regenerative braking.

UNIT-II **[Text Book - 1]**

Electric Heating:

Modes of heat transfer, Stefan's law, electric furnaces, resistance heating, heating element properties, design of heating element, losses and efficiency, temperature control of resistance ovens, arc furnaces, induction heating - Construction and working of different types of induction furnaces. Dielectric heating.

Welding:

Types of welding, resistance and arc welding, Characteristics of carbon and metallic arc welding- comparison, ultrasonic welding, laser beam welding.

UNIT –III **[Text Book-1]**

Illumination:

Terms used in illumination, Laws of illumination – inverse square law and Lambert's cosine law, Polar curves, Gas discharge lamps- sodium vapour lamp, mercury vapour lamp,

	fluorescent lamp, CFL, LED lighting. Design of street lighting, flood lighting and factory lighting. **UNIT IV** **[Text Book - 1]** **Refrigeration:** Introduction to refrigeration, refrigeration cycle, vapour compression refrigeration system, domestic refrigerator. **Air- Conditioning:** Introduction to air conditioning, summer air conditioning systems, winter air conditioning systems , year-round air conditioning systems, room air conditioning systems, central air conditioning systems, sizing of air conditioning system .
Text books and Reference books	**Text Book(s):** [1] J.B Gupta," *Utilization of Electric power and Electric Traction*", S.k.kataria& sons, 10th edition, 2013. [2] R.K.Rajput," *Utilization of Electrical Power*", Laxmi Publications Pvt., Ltd., New Delhi, fifth edition: 2006. **Reference Books:** [1] Umesh Rathore "Energy management", S.K Kataria & sons, second edition 2014 [2] H. Partab, "Art And Science Of Utilization Of Electrical Energy" Dhanpat Rai & Co.(P) Ltd, 3rd edition, 2011. [3] E. Openshaw Taylor, "Utilization of Electric Energy", Orient Longman Private Limited, SI edition 2006.
E-resources and other digital material	"Illumination Engineering and Electric Utility Services" by Prof. N.K.Kishore, Dept of Electrical Engineering, IIT-Kharagpur. http://nptel.ac.in/courses/108105060/

14EE3702 – SWITCHGEAR AND PROTECTION

Course Category:	Programme core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3- 1 - 0
Prerequisites:	Transformers and Induction Motors(14EE3405), Electrical Measurements (14EE3406), Synchronous and Special Machines (14EE3504), Power Systems-I (14EE3507**)**	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Understand the concept and working principle of various types of circuit breakers.											
	CO2	Understand the working principle of different protective relays.											
	CO3	Learn various protection schemes of major power system equipment; Understand the concepts of over voltage phenomenon and its protection methods.											
	CO4	Understand the working principle of different static protective relays.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	H	M		M		M	L	M			
	CO2	H	H	M		M		M	L	M			
	CO3	H		M		M		M	L	M			
	CO4	M	L	M		M		M	L	M			

Course Content

UNIT-I **[Text Book-1]**

Fuses and Circuit Breakers:

Introduction of fuses – characteristics – Types of fuses. Introduction to Circuit Breakers - Arc phenomenon, Arc interruption theories, Arc restriking and recovery voltages, current chopping, resistance switching, classification of circuit breakers, oil circuit breakers, Air Circuit Breakers, Vacuum circuit breakers, SF_6 circuit breakers, ratings of circuit breakers, testing of circuit breakers, differences between MCCB, RCCB, MCB and ELCB. Auto recloser.

UNIT-II **[Text Book-1]**

Electromagnetic Relays:

Introduction, functional characteristics of the protective relays, relay operating principle, basic relay contact diagram, classification of relays, Electromagnetic attraction relays, Thermal relay, Buchholz relay, Electromagnetic Induction type relays, differential relays, universal torque equation, Impedance relays, reactance relay and Mho relay.

	UNIT-III **[Text Book-1]** **Power System Protection:** Types of faults, detection of faults and their effects, alternator protection schemes – Stator, rotor and reverse power protection. Transformer protection - external and internal faults protection. Bus bar protection schemes. Transmission line protection – current, time grading and distance protection schemes, Pilot relaying schemes – Circulating current and balanced voltage scheme. Power line carrier protection – Phase comparison carrier current protection. **Protection Against Over Voltages**: Causes of over voltages, Lightning Phenomena, Protection of Transmission Lines and Substations against Lightning strokes, Protection against travelling waves - Types of arrestors and surge absorbers. **UNIT-IV** **[Text Book-2]** **Advance Protection Schemes:** ***Static Relays****:* Introduction of static relays, merits and demerits, functional block diagram. Instantaneous, Definite time, Inverse time and Directional static over current relays. Static differential relay. ***Comparators****:* Amplitude and phase comparators, duality, static distance relay schemes – Impedance relay, reactance relay and Mho relays using amplitude and phase comparators; Realization of reactance and mho relay using sampling comparator. **[Text Book-3]**
Text books and Reference books	**Text Book(s):** [1] J.B Gupta, "Switchgear and Protection", S.K.Kataria & Sons, Third edition, 2013. [2] C.L. Wadhwa, "Electrical power systems, New age international (P) Ltd., Tata McGraw Hill, Fourth edition, 2015. [3] Badri Ram & D.N.Vishwakarma, "Power System Protection and Switchgear", Tata McGraw Hill, Second edition, 2011. **Reference Books:** [1] Sunil.S.Rao, "Switchgear Protection and Power Systems", Khanna Publishers, New Delhi, Dec 2008. [2] B.Ravindranath and M.Chander "Power System Protection and Switchgear ",New Age International publishers, Second edition ,2011.
E-resources and other digital material	http://nptel.ac.in/courses/108101039/ (NPTEL lectures on Power System Protection by Prof. S.A. Soman ,IIT Bombay)

14EE3703 – POWER SYSTEM ANALYSIS

Course Category:	Programme core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Complex Analysis and Numerical Methods(14MA1301) Network Analysis-I(14EE3303) Transformers and Induction Motors(14EE3405) Synchronous and Special machines(14EE3504) Power Systems –II(14EE3605)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Model the components of a power system, estimate per unit values and formulate Y Bus											
	CO2	Perform power flow analysis and analyze symmetrical faults.											
	CO3	Apply symmetrical components to analyze the unsymmetrical faults.											
	CO4	Explain steady state and transient stabilities; Analyze transient stability using equal area criterion											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	M					M					
	CO2	H	H			H		M			H		
	CO3	H	H			H		M			H		
	CO4	H	H			H		M			M		

Course Content

UNIT-I **[Text Book-1]**

Representation of Power Systems:

Modeling of power system components, per unit system, single line diagram, Impedance/Reactance diagrams.

Formulation of bus admittance matrix (Y_{bus}) using inspection method and singular transformation method.

UNIT–II **[Text Book-1]**

Power Flow Studies:

Introduction – Significance of power flow study- Classification of buses –- Formulation of Power flow problem -Solution methods –Gauss-Seidel and Newton Raphson iterative

	methods (with Polar Coordinates only), decoupled and fast decoupled methods. **Symmetrical Fault Analysis: [Text Books -1 & 2]** Introduction – Short circuit analysis of unloaded & loaded synchronous machines - short circuit current computation through Thevenin's theorem, selection of circuit breakers. **UNIT–III [Text Book-1]** **Symmetrical Components :** Introduction, Symmetrical component transformation, Power in terms of symmetrical components, phase shift in star/delta transformers, sequence impedances of power system components, construction of sequence networks of a power system. **Unbalanced Faults Analysis:** Introduction - single line to ground fault, line–to-line fault, double line – to – ground fault, open conductor faults. **UNIT–IV [Text Book-2]** **Power System Stability:** Introduction – Concept & definitions of power system stability - Power angle equation of Salient and Non-Salient pole synchronous machines - Dynamics of Synchronous machine - development of the swing equation for single machine connected to infinite bus and two machine systems. - swing curves. Equal area criterion, step by step method. Factors affecting stability, methods of improving stability.
Text books and Reference books	**Text Book(s):** [1] D.P.Kothari & I.J.Nagrath, "Modern power system analysis", Tata Mc.Graw Hill, 4th edition, 2011. [2] W.D.Stevenson. Jr, "Elements of Power System Analysis", by, Mc.Graw Hill, 4th Edition, 1982. **Reference Books:** [1] Ashfaq Hussain, "Electrical Power Systems", CBS Publishers & Distributors, 5th edition, 2010. [2] [2]T.K.Nagsarkar, M.S.Sukhija, "Power System Analysis", by Oxford university press, 2007
E-resources and other digital material	http://freevideolectures.com/Course/2353/Power-Systems-Analysis

14EE3704 – INDUSTRIAL DRIVES

Course Category:	Programme Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 1 - 0
Prerequisites:	DC Machines(14EE3305), Transformers and Induction Motors (14EE3405), Synchronous and Special Machines (14EE3504), Power Electronics(14EE3602)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Analyze the basic concepts of electric drives.											
	CO2	Analyze braking, speed control methods of dc drives and converter-fed and chopper-fed dc drives.											
	CO3	Analyze braking and speed control methods of induction motor drive.											
	CO4	Analyze the operation of synchronous motor drives and special drives.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H				L							
	CO2	H	H	M		M					L		
	CO3	H	H	M		M					L		
	CO4		H	M		M					L		

Course Content

UNIT I **[Text Book-1]**

Electric Drives:

Introduction- Advantages- parts of electrical drives-Fundamental torque equation- Multi quadrant operation- Components of load torques- Modes of operation- Closed loop control of drives- Thermal model of motor-Classes of motor duty- Determination of motor rating – types of loads.

UNIT II **[Text Book-1]**

DC Motor Drives:

DC motors & their performance- Braking- Speed control- Methods of armature voltage control- Transformer & rectifier control- Single Phase & Three Phase controlled converter fed dc separately excited motor- rectifier control of dc series motor- Chopper controlled dc drives.

UNIT III **[Text Book-1]**

Induction Motor Drives:

	Introduction- Braking - Speed control - V/f Control- Pole Changing- Pole Amplitude modulation- Stator Voltage Control- Variable Frequency Control of Induction motor- Voltage Source Inverter& Current Source Inverter fed Induction motor drives- Eddy Current Drives- Rotor resistance control- Static rotor resistance control- Slip Power Recovery– DFIG (Elementary Treatment). **UNIT – IV** **[Text Book-1]** **Synchronous Motor and Special Drives:** Introduction to Synchronous motor drives- True synchronous & Self control modes of operation of synchronous motor drives – Principle & operation of brushless dc motor, Stepper motors, PMSM, Switched Reluctance Motor.
Text books and Reference books	**Text Book(s):** [1] "Fundamentals of Electrical Drives" by Gopal K. Dubey, Narosa Publishing House. **Reference Books:** [1] "Modern Power Electronics and AC Drives" by Bimal K.Bose , Prentice Hall of India, 2005 [2] "Thyristor control of Electrical Drives" by Vedam Subramanyan, Tata Mc Graw Hill Publications.
E-resources and other digital material	http://nptel.ac.in/courses/108102046/#

14EE4705/1 – HVDC TRANSMISSION

Course Category:	Programme Elective – I	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Power Electronics(14EE3602)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Understand the concept, planning of DC power transmission and comparison with AC Power transmission
	CO2	Analyze HVDC converters
	CO3	Understand concept of control and converter fault
	CO4	Under the concept of harmonics and design of filters

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)(L – Low, M - Medium, H – High)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		L		L			H				
CO2	M		H		H			L				
CO3	H		L		M			H				
CO4	L		H		H			H				

Course Content

UNIT–I **[Text Book-1]**

Basic Concepts:

Introduction to DC power transmission technology, Comparison of economical, technical and reliable factors of HVDC transmission systems, Advantages and disadvantages of HVDC transmission, Types of HVDC Links, Apparatus required for HVDC systems, Application of DC transmission system, Planning and Modern trends in DC transmission.

UNIT–II **[Text Book-2]**

Analysis of HVDC Converters:

Introduction to converter technologies, Choice of optimal circuit configuration for HVDC converters, Detailed analysis of Graetz circuit (six-pulse converter bridge)- overlap angle less than sixty degrees and greater than sixty degrees, Inverter operation, Complete equivalent circuit of HVDC link, Characteristic analysis of converter as rectifier/inverter, Introduction to twelve pulse converter.

UNIT–III **[Text Book-2]**

Converter and HVDC System Control:

Basic principles of DC link control, Ideal converter control characteristics, Combined

	characteristics of rectifier and inverter, Firing angle control schemes - individual phase angle control, equidistant pulse control, Effect of source inductance on the system, Starting and stopping of DC link. **Converter Faults and Protection:** Nature and type of faults, Converter faults – arc through, arc back, misfire, quenching, commutation failure, short circuits in bridge, Protection against over currents and over voltages in converter station, Surge arresters, Smoothing reactors, Protection of DC line, DC breaker. **UNIT-IV** **[Text Book-1]** **Harmonics and Filters:** Generation of harmonics, Characteristic harmonics, Non-characteristic harmonics, Adverse effects of harmonics, Calculation of voltage & current harmonics, Effect of Pulse number on harmonics. Types of filters, Design factors of filters, Design of single tuned filter, Design of minimum cost single tuned filter, DC filters. **MTDC Systems:** Multi terminal DC (MTDC) system, Potential applications of MTDC systems, Types of MTDC systems, Comparison of series and parallel MTDC systems, Introduction of control and protection of MTDC systems.
Text books or Reference books	**Text Book(s):** [1] K. R. Padiyar, "HVDC power transmission system", Wiley Eastern Limited, New Delhi 1990. First edition. [2] E. W. Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971. **Reference Books:** [1] C. Adamson and N. G. Hingorani, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960. [2] J. Arrillaga, "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983. [3] R. D. Begamudre, "Extra High Voltage AC Transmission Engineering", New Age Interantional (P) Ltd., New Delhi, 1990. [4] P. Kundur "Power System Stability and Control", McGraw-Hill, 1993. [5] S. Kamakshaiah, and V. Kamaraju, 'HVDC Transmission', Tata McGraw Hill Education Private Limited, 2011.
E-resources and other digital material	http://www.nptelvideos.in/2012/11/high-voltage-dc-transmission.html High Voltage DC Transmission by Prof. S. N. Singh, Department of Electrical Engineering, IIT Kanpur.

14EE4705/2: COMPUTER NETWORKS

Course Category:	Programme Elective – I	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Demonstrate various standard network models.
	CO2	Analyze error detection and error correction codes.
	CO3	Understand routing issues in network design.
	CO4	Analyze the underlying protocols in transport layer and Identify different applications in Application layer.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2	M	M			H							
CO3	H	L	L		H							
CO4	L	L			L							

Course Content

UNIT-I **[Text Book-1]**

Introduction:

Uses of Computer Networks, Network Hardware, LANs, MANs, WANs, Network Software.

Reference Models:

The OSI Reference Model, TCP/IP Reference Model, the comparison of the OSI and TCP/IP reference models.

Physical Layer:

Guided transmission media: Magnetic Media, Twisted Pair, Coaxial Cable, and Fibre Optics

UNIT-II **[Text Book-1]**

Data Link Layer:

Data link layer design issues, Error detection and correction, Elementary data link protocols, and Sliding window protocols.

Medium Access Control Sub layer:

The channel allocation problem, Multiple access protocols, ETHERNET.

UNIT-III **[Text Book-1]**

Network Layer:

Network Layer Design Issues, Routing Algorithms: Shortest Path, Flooding, DVR, and Link State routing algorithm, Congestion Control Algorithms.

	Quality of Service: Techniques for achieving good quality of service, IP Protocol, IP addresses, Internet Control Protocols. **UNIT-IV** **[Text Book-1]** **Transport Layer:** The Transport Service, Elements of Transport Protocols, and the Internet Transport Protocols TCP and UDP. **Application Layer:** The Domain Name System (DNS), and E-Mail.
Text books and Reference books	**Text Book(s):** [1] Andrew S Tanenbaum, "*Computer Network",* 4 ed, Pearson Education / PHI **Reference Books:** [1] Kurose and Ross, "*Computer Networks – A Top-down Approach Featuring the Internet",* Pearson Education. [2] Behrouz A.Forouzan, "*Data Communications and Networking".* 4 ed, TATA McGraw Hill. Nader F.Mir, *Computer and Communication Networks.* PHI
E-Resources and other digital material	

14EE4705/3 – OPTIMIZATION TECHNIQUES

Course Category:	Programme Elective – I	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Linear Algebra and Differential Equations (14MA1101) Calculus (14MA1201)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Formulate and solve LP Problem											
	CO2	Solve non linear Programming Problems, Assignment & Transportation Problems											
	CO3	Apply search methods to solve optimization Problems											
	CO4	Understand the basics of Nontraditional optimization Techniques, solve LPP using Dynamic Programming											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H				H							
	CO2	H				M				M			
	CO3	H				M							
	CO4	L								H		H	

Course Content

UNIT – I **[Text Book-1]**

Linear Programming:

Introduction and formulation of models, Standard and canonical forms of LPP, assumptions in LPP, Graphical Method, simplex method, simplex method using Artificial Variables, degeneracy in simplex method, duality in L.P., dual simplex method, sensitivity analysis: change in coefficients of objective function.

UNIT – II **[Text Book-1]**

Assignment Problem: Hungarian Method.

Transportation Problem:

Vogel's Approximation Method, MODI Method.

Non-linear Programming:

Unconstrained problems of maxima and minima, Constrained problems of maxima and minima. Lagrangian Method, Kuhn Tucker conditions.

UNIT – III **[Text Book-2]**

Search Methods:

Single variable search methods: Exhaustive search, Interval Halving method, Fibonacci search.

Multi variable search methods: Univariate search method, Steepest descent and ascent

	methods, Conjugate gradient (Fletcher – Reeves) method. **UNIT-IV** **[Text Book-1 & 3]** **Dynamic Programming:** Solution of linear programming problem, simple problems. **Heuristic optimization Techniques:** Fundamentals of Evolutionary algorithms, trajectory based methods – genetic algorithm and swarm intelligence based algorithms – Particle swarm optimization. Advantages and disadvantages of Nontraditional optimization Techniques.
Text books and Reference books	**Text Book(s):** [1] S. D. Sharma, "*Operations Research*", 12th edition, Kedar Nath Ram Nath & Co. [2] S. S. Rao, "*Engineering Optimization: Theory and Practice*", 3rd edition, New Age International, 1998. [3] Kalyanmoy Deb, "*Optimization for Engineering Design: Algorithms and Examples*", 2nd edition, PHI Learning Pvt. Ltd., 2012. **Reference Books:** [1] K.V.Mittal and C. Mohan, "*Optimization Methods in Operations Research and Systems Analysis*", 3rd edition, New Age International, 1996. [2] H.A.Taha, "*Operations Research: An introduction*", 6th Edition, PHI Learning Pvt. Ltd. [3] G.Hadley, "*Linear Programming*" Indian Student Edition, Narosa Publishing House, 1994. [4] D.P Kotari and J.S.Dhillon, "Power system optimization" 2nd edition, PHI Learning Pvt. Ltd., 2011.
E-Resources and other digital material	

14EE4705/4 – INTERNET OF THINGS (IOT)

Course Category:	Programme Elective – I	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Microcontrollers and Digital Signal Processor(14EE3503)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Understand the concepts and components of Internet of Things
	CO2	Understand the methods of communicating **w**ith internet
	CO3	Identify the Embedded platform for implementing Internet of Things
	CO4	Apply the concepts of IOT in real time applications

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				L				L	L	L	L	
CO2	M		M									
CO3			M						H			
CO4			H						M		M	

Course Content

UNIT I [**Text Book-1**]

Introduction:

Vision, definition, conceptual frame work, Architectural overviews of IBM and Oracle, Major components of IOT devices, Control units, sensors

UNIT II **[Text book -1]**

Internet Connectivity:

Internet connectivity, Internet based communication, IP addressing of IOTs, MAC, Application Layer Protocols.

Cloud Computing:

Definition of cloud computing-Components-Models and Architecture, Benefits, communicating with cloud using Web services

Unit III **[Text book -1]**

Embedded Platforms For IOT:

Embedded computing basics**,** Overview of IOT supported Hardware platforms such as Arduino, Net Arduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex.

Hardware for IOT:

Sensors, digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology.

Unit IV **[Text book -3]**

Programming the Arduino:

	Arduino platform boards anatomy, Arduino IDE, coding, using emulator, using libraries, additions in Arduino, programming the Arduino for IOT. **Applications:** Smart metering, city automation, automotive applications, home automation, smart cards, Communicating data with hardware units, mobiles, tablets, designing of smart street lights in smart city.
Text books and Reference books	**Text Book(s):** [1] Raj kamal, "*Embedded Systems Architecture, Programming and Design*". 2 ed, McGraw-Hill, 2008 [2] Kenneth J. Ayala, "8051 Micro Controller Architecture" Thomson Delmar Learning, 3RD Edition, 2005 [3] Raj Kamal "*Internet of Things*", McGraw-Hill, 1st, Edition, 2016. **Reference books:** [1] Arshdeep Bahga, Vijay Madisetti " Internet of Things(A hands on approach)" 1ST edition, VPI publications,2014
E-Resources and other digital material	**"Introduction to Internet of Things"** by Prof. Raj Jain, Washington University, https://www.youtube.com/watch?v=oc_qzTj26k&list=PLw5h0DiJ9PCxDZkP8pbgpyiDweF3DJ8c. ***(Accessed on 16 February 2016)***

14EE4706/1 – ELECTRICAL DISTRIBUTION SYSTEMS

Course Category:	**Programme Elective – II**	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Power System – I(14EE3507)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	**Summarize** Distribution Systems Planning and Automation
	CO2	**Describe** Design considerations of Sub Transmission Lines and Distribution Substations
	CO3	**Describe** Design Considerations of Primary Systems and secondary systems
	CO4	**Analyze** Voltage Drop and Power Loss Calculations in distribution systems

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H					H				
CO2			H					H				
CO3		M	H					H				
CO4	M	H			H			M				

Course Content

UNIT–I **[Text Book-1]**

Distribution Systems Planning and Automation:

Introduction, distribution system planning, factors affecting system planning, substation site selection. Distribution planning techniques (present and future), role of the computerin distribution planning, distribution system automation and control functions.

Load Characteristics:

Types of load characteristics, relationship between the load and loss factor. Load growth and rate structure.

UNIT–II **[Text Book-1]**

Design of Sub Transmission Lines and Distribution Substations:

Introduction, sub transmission systems, distribution substation, Substation bus schemes, description and comparison of switching schemes, substation location, rating of a distribution substation, substation service area with n primary feeders, comparison of four and six feeder patterns.

UNIT–III **[Text Book-1]**

Design Considerations of Primary Systems:

Introduction. Types of feeders: Radial type, loop type primary feeders. Primary network, primary feeder voltage levels, primary feeder loading, radial feeders with uniformly

	distributed load and non uniformly distributed loads **Design Considerations of Secondary Systems**: Introduction, secondary voltage levels, Secondary banking, secondary networks - grid network, spot network, secondary mains. **Distribution System Protection:** Basic definitions, over current protection devices - fuses, automatic circuit reclosers, automatic line sectionalisers, automatic circuit breakers. Objectives of distribution system protection, coordination of protective devices - fuse to fuse co-ordination, recloser to fuse coordination, fuse to circuit breaker co-ordination, recloser to circuit breaker co-ordination **UNIT-IV** **[Text Book-1]** **Voltage Drop and Power Loss Calculations**: Voltage drop and loss calculation in single and three phase primary lines, and four wire multi grounded primary lines, distribution feeder costs. Applications of Capacitors in Distribution Systems: Effect of series and shunt capacitors, power factor correction, economic justification for capacitors, procedure to determine the best capacitor location. Distribution System Voltage Regulation- Quality of service, voltage control and line drop compensation.
Text books and Reference books	**Text Book(s):** [1] Turan Gonen," *Electric Power Distribution system Engg* ," CRC press, 3rd edition, 2014. **Reference Books:** [1] A.S.Pabla .Jr.,"*Electric Power Distribution* ", Tata Mc.Graw Hill Ltd, 4th ed., 1997
E-Resources and other digital material	

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14EE4706/2–AI TECHNIQUES IN ELECTRICAL ENGINEERING

Course Category:	Programme Elective-II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Linear control Systems(14EE3501) Power Electronics(14EE3602)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Explain single layer and multi-layer neural networks.
	CO2	Explain the concepts of Genetic Algorithms
	CO3	Explain the concepts of Fuzzy logic systems
	CO4	Apply soft computing techniques to Electrical Engineering Problem.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M		H	H	H	H		H	M		
CO2	H	M		H	H	H	H		H	M		
CO3	H	M		H	H	H	H		H	M		
CO4	H	M	L	H	H	H	H		H	M		

Course Content

UNIT–I **[Text Book-1]**

Introduction to Neural Networks :

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models. Introduction - neural network models-architectures-knowledge representation-learning process-learning tasks. Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perception Convergence theorem, Limitations of the Perceptron Model, Back propagation-RBF algorithms-Hope field networks, Applications.

UNIT–II **[Text Book-1]**

Genetic algorithms

Introduction-encoding-fitness function-reproduction operators, genetic operators-cross over and mutation-generational cycle- convergence of genetic algorithm.

Genetic Algorithm applications: Economic Load dispatch, Multi variable Optimization problems.

UNIT–III **[Text Book-1]**

Classical and Fuzzy Sets :

Introduction to classical sets - properties, operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions. Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

	UNIT–IV **[Text Book-2]** ***Neural network applications:*** NN Application to Harmonic Minimization in Inverters, Load forecasting in power systems, Process control and estimation. ***Fuzzy logic applications:*** Fuzzy logic control and Fuzzy classification specific applications to power systems load frequency control, fault diagnosis.
Text books and Reference books	**Text Book(s):** [1] Chennakesava RAlavala, "*Fuzzy logic and neural networks"*, New Age International Publishers., [2] Rajasekharan and Pai, "*Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications"* PHI Publication. [3] Jacek M. Zuarda," *Introduction to Artificial Neural Systems",*Jaico Publishing House, 1997 **References Books:** [1] N. Yadaiah and S. Bapi Raju, "*Neural and Fuzzy Systems: Foundation, Architectures and Applications"*, - Pearson Education [2] C.Eliasmith and CH.Anderson, "*Neural Engineering*", PHI.
E-resources and other digital material	

14EE4706/3 DATABASE MANAGEMENT SYSTEMS

Course Category:	**Programme Elective-II**	**Credits:**	3
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Programming in C (14CS1203)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand different types of Database Concepts											
	CO2	Design E-R and Relational Model for an application.											
	CO3	Apply Normalization Process for Database Design											
	CO4	Understand Concurrency Control and Recovery Techniques of DBMS											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	L											
	CO2		M	H								L	
	CO3		M	H								L	
	CO4		M	H								L	

Course Content

UNIT I **[Text Book-1]**

Databases and Database Users:
Characteristics of the database approach, advantages of using the dbms approach, a brief history of database applications. database system concepts.

Architecture:
Data models, schemas, and instances, three-schema architecture and data independence.

UNIT II **[Text Book-1]**

Data Modeling Using the Entity-Relationship (ER) Model:
Using high-level conceptual data models for database design, entity types, entity sets, attributes, and keys, relationship types, relationship sets, roles, and structural constraints, weak entity types, er diagrams, naming conventions, and design issues, relationship types of degree higher than two.

Relational Database Design by ER and EER-to-Relational Mapping:
Relational database design using ER-to-relational mapping. the relational data

Model and Relational Database Constraints:
Relational model concepts, relational model, constraints and relational database schemas. Relational algebra.

	Unary Relational Operations: SELECT and PROJECT, relational algebra operations from set theory, binary relational operations: JOIN and DIVISION, additional relational operations, examples of queries in relational algebra. **UNIT III** **[Text Book-1]** **SQL:** The relational database standard. Data definition, constraints, and schema changes in SQL. basic queries in SQL. More complex SQL queries. Insert, delete, and update statements in SQL. Insert, delete, and update statements in SQL. Triggers and assertions. **basics of functional dependencies and normalization for relational databases:** Functional dependencies, normal forms based on primary keys, general definitions of second and third normal forms, Boyce-Codd normal form, multi valued dependencies and fourth normal form, join dependencies and fifth normal form. **UNIT IV** **[Text Book-1]** **Introduction to Transactions Processing:** Introduction to transaction processing, transaction and system concepts, desirable properties of transactions. **Concurrency Control Techniques and Database Recovery Techniques:** Two phase locking techniques for concurrency control, The ARIES Recovery Algorithm.
Textbooks and Reference books	**Text Book(s):** [1] Elmasri and Navathe, "*Fundamentals of Database Systems"*. 5 ed, Addison Wesley, Pearson Education Inc., 2000. **Reference Books:** [1] C. J Date, "*An Introduction to Database Systems"*. Pearson Education. [2] Raghu Ramakrishnan, "*Database Management Systems"*. Tata McGraw Hill. [3] AviSilberschatz Henry F. Korth and S. Sudarshan, "*Database System Concepts"*. Tata McGraw-Hill Publications
E-resources and other digital material	[1] DrS.Srinath IIT-Madras ―Conceptual design process ― http://nptel.iitm.ac.in/video.php?subjectId=106106093 [2] Prof P.Srinivasa Kumar IIT-Madras ― Normalization process‖ http://nptel.iitm.ac.in/courses/IIT-MADRAS/Intro_to_Database_Systems_Design/ [3] Prof D.Janakiram IIT-Madras ―Concurrency Control techniques‖ http://nptel.iitm.ac.in/video.php?subjectId=106106093

14EE4706/4 VLSI DESIGN

Course Category:	Programme Elective-II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Programming in C (14CS1203)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand IC Fabrication process steps required for various MOS circuits.											
	CO2	Design E-R and Relational Model for an application .											
	CO3	Apply Normalization Process for Database Design											
	CO4	Understand Concurrency Control and Recovery Techniques of DBMS											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	L											
	CO2		M	H								L	
	CO3		M	H								L	
	CO4		M	H								L	

Course Content

UNIT I **[Text Book-1&2]**

Introduction:

Introduction to MOS Technology – MOS, PMOS, NMOS, CMOS and BiCMOS technologies, fabrication fundamentals: Oxidation, Lithography, Diffusion, Ion implantation, Metallization and Encapsulation.

Basic Electrical Properties:

Basic Electrical Properties of MOS ,CMOS and BiCMOS Circuits: I_{DS}-V_{DS} relationships, MOS transistor threshold Voltage, g_M, g_{DS}, figure of merit w_o, Pass transistor, NMOS inverter, Various pull - ups, Determination of pull-up to pull-down ratio(Z_{pu} / Z_{pd}) , CMOS Inverter analysis and design, BiCMOS inverters, Latch-up in CMOS circuits.

UNIT II **[Text Book-1&2]**

VLSI Circuit Design Processes:

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layouts, Lambda based design rules, Contact cuts , CMOS Lambda based design rules, Layout Diagrams for logic gates, Transistor structures, wires and vias, Scaling of MOS circuits- Scaling models, scaling factors, scaling factors for device

	parameters, Limitations of Scaling **UNIT III** **[Text Book-1&2]** **Gate Level Design And Layout:** Architectural issues, Switch logic networks: Gate logic, Alternate gate circuit: Pseudo-NMOS Dynamic CMOS logic. Basic circuit concepts, Sheet Resistance R_S and its concept to MOS, Area Capacitance Units, Calculations, The delay unit T, Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out, Choice of layers **UNIT IV** **[Text Book-1&2]** **Subsystem Design:** Subsystem Design, Shifters, Adders, ALUs, Multipliers: Array multiplier, Serial-Parallel multiplier, Parity generator, Comparators, Zero/One Detectors, Up/Down Counter, Memory elements. **Semiconductor Integrated Circuit Design:** PLDs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Programmable Logic Array Design Approach.
Textbooks and Reference books	**Text Book(s):** [1] Kamran Eshraghian, Dougles and A. Pucknell, "Essentials of VLSI circuits and systems", PHI Edition, 2005. [2] Wayne Wolf, "Modern VLSI Design", Pearson Education, 3rd Edition, 1997. **Reference Books:** [1] Neil H.E Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design – A circuits and systems perspective", Pearson Education, 2009. [2] John P. Uyemura , "CMOS logic circuit Design", Springer , 2007. [3] K. Lal Kishore, V S V Prabhakar, "VLSI Design", I.K..International, 2009. [4] A.Albert Raj, Latha "VLSI Design", PHI, 2008. [5] Mead and Convey, "Introduction to VLSI Design", BS Publcations, 2010. [6] M. Michal Vai, "VLSI Design", CRC Press, 2009.
E-resources and other digital material	

14EE3751 –POWER SYSTEM LABORATORY

Course Category:	**Programme core**	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 0 – 3
Prerequisites:	Switch gear and Protection(14EE3702) Power System –I(14EE3507)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Design and conduct experiment.											
	CO2	Analyze and present experimental results.											
	CO3	Exhibit professional behavior											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1		M		H								
	CO2				H			H					
	CO3				H			M					

Course Content

1. Determination of ABCD parameters of transmission line model
2. Performance of transmission line
3. Characteristics of electromagnetic relay
4. Characteristics of Static relay
5. Characteristics of microprocessor based relay
6. Sequence impedances of transformer
7. Sequence impedances of alternator
8. Single line to ground fault study on unloaded alternator
9. Determination of sub-transient, transient, steady-state reactance of an alternator
10. Determination of sub transient direct and quadrature axis reactances (X_d'' &X_q'') of Alternator
11. Reactive power compensation using tap changing transformer.
12. Short circuit analysis using AC network analyzer
13. Develop a program for Y_{bus} by direct inspection method
14. Develop a program for load flow analysis by Gauss - Seidel iterative method.
15. Characteristics of air circuit breaker.
16. High voltage testing of insulators and cables
17. Study of corona phenomena

NOTE: In all laboratories a minimum of 10 experiments are to be completed.

14EE3752 – POWER ELECTRONICS LAB

Course Category:	Program core	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:	Power Electronics14EE3602, Electronic Circuits(14EE3402)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:										
	CO1	Design and conduct experiment.										
	CO2	Analyze and present experimental results.										
	CO3	Exhibit professional behavior										
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1		M		H								
	CO2				H			H					
	CO3				H			M					

Course Content

LIST OF EXPERIMENTS

1. Static characteristics of SCR
2. Static Characteristics of MOSFET & IGBT.
3. Single phase fully controlled rectifier with R, R-L & R-L-E load (With or without feedback diode)
4. Single phase Dual converter with R & RL loads (Circulating & Non-Circulating modes)
5. Three phase fully/half controlled rectifier with R & R-L, R-L-E loads.
6. Single phase AC voltage controller with R & R-L loads
7. IGBT/MOSFET based H-bridge inverter with R& RL Loads
8. Step down and step up MOSFET based choppers
9. Speed control of 3-phase induction motor by using 3-phase voltage source inverter
10. Forced commutation Techniques of SCR
11. Multi-level inverter (advanced Experiment)
12. Frequency Control Single phase cyclo-converter (Centre tapped or Bridge)

	13. Simulation of single phase fully controlled with R & R-L, R-L-E loads. 14. Simulation of single phase step down/step up chopper 15. Simulation of Single phase bridge inverter
Text books and Reference books	**Text Book(s):** [1] Power Electronics: Circuits, Devices and Applications-by P.S.Bimbhra , khanna Publishers [2] Power Electronics– byM. D. Singh & K. B.Kanchandhani, Tata Mc Graw–Hil Publishing company, 1998.

NOTE: In all laboratories a minimum of 10 experiments are to be completed.

14EE3753 – MINI PROJECT

Course Category:	Program core	**Credits:**	2
Course Type:		**Lecture - Tutorial - Practice:**	0 - 1 - 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Identify and find solution/part of solution to the real world problems.											
	CO2	Propose a methodology for implementing the solution.											
	CO3	Get awareness on design methodologies/Programming Techniques using modern engineering tools.											
	CO4	Write technical reports.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1												
	CO2												
	CO3												
	CO4												
Description	This may be continuity to the term paper work in the sixth semester. The solution methodology for the identified problem is to be identified. The student has to get awareness on different software/hardware tools necessary for implementing the solution methodology. The students has to submit a report which cover the literature survey, implementation methodology and also the simulation/Hardware results obtained by the end of the semester in the prescribed format mentioned by the department. In addition to the above the students have to present a power point presentation in front of the project review committee for continuous assessment.												

14EE3801 – POWER SYSTEM OPERATION AND CONTROL

Course Category:	**Programme core**	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 1 - 0
Prerequisites:	Power System-I (14EE3507) Power Electronics(14EE3602) Power System-II(14EE3605)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Dispatch load economically among Thermal plants.
	CO2	Model LFC and AGC for one and two area power systems.
	CO3	Model AVR for an isolated thermal system and Explain different methods of voltage control in transmission and distribution systems.
	CO4	Explain the functions of power system control centers and distribution automation using SCADA.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H				M		M			H		
CO2	H		H				M					
CO3	M		H				M			H		
CO4	L						M			H		

Course Content

UNIT–I

Economic operation of power systems: **[Text Book – 1,3]**

Economic dispatch in thermal power stations:- Heat rate curves, cost curves, incremental fuel and production costs, economic distribution of load between units without consideration to line losses; transmission line losses as a function of plant generation, calculation of loss coefficients, optimum generation allocation between thermal plants; unit commitment - constraints, Priority List method .

UNIT–II

Power System Control **[Text Book – 1]**

Importance of keeping voltage and frequency constant in a power system; Generator Basic Control Loops; Schematic diagram of LFC and AVR of a synchronous generator; Load frequency control (LFC) single area case, the P-δ loop: mathematical modeling of generator, loads, prime mover and speed governor for LFC & corresponding block diagram representation, LFC block diagram of an isolated power system , steady state analysis, dynamic response. The automatic generation control (AGC) scheme – AGC in a single area system, block diagram representation of AGC for an isolated power system. Two area LFC.

UNIT–III

Reactive Power and Voltage Control:

Reactive power control in synchronous generators: **[Text Book - 1]**

The role of excitation system- exciter, generator and sensor models, simplified AVR

	block diagram, steady state response for a step change in terminal voltage. ***Reactive power compensation of loads:*** **[Text Book - 2]** Shunt compensating devices **Transmission line compensation**: Introduction to FACT devices - Series compensation, static VAR compensators – Thyristor controlled reactors (TCR), Thyristor switched capacitors (TSC), combined TCR and TSC. **Voltage control of distribution systems**: **[Text Book - 2]** Tap changing, booster transformers, synchronous phase modifiers. **UNIT–IV** **Power System Control centers:** **[Ref Book - 2]** Aim of control centers, Functions of Control centers – Planning, Monitoring & Data acquisition and System control. Setup, locations, central & civil facilities. Facilities in control room. Communication-PLCC. Emergency control. **Distribution Automation:** **[Ref Book - 3]** Flow diagram for man machine power system interface. Schematic diagram of Remote Terminal Unit, SCADA system.
Text books and Reference books	**Text Book(s):** [1] H. Saadat, "Power system analysis" Tata McGraw Hill , edition 2003 [2] C.L Wadhwa, "Electrical Power systems", New Age International Publications, six edition, 2009. [3] D.P.Kothari & I.J.Nagrath, "Modern power system analysis by" Tata McGraw Hill Third edition, 2008. **Reference Books**: [1] John J. Grainer and WD Stevenson, "Power system analysis" Tata McGraw Hill, edition 2003.. [2] Abhijit Chakrabarti & Sunita Halder, "Power System Analysis operation and control" PHI Publications, 2009. [3] CL Wadhwa, "Generation Distribution and utilization of Electrical Energy", New Age publications, Second edition. [4] Allen J Wood, Bruce F. Wollenberg, "Power Generation Operation and Control" Wiley-India publication, Second edition, 2010.
E-resources and other digital material	http://www.nptelvideos.in/2012/12/power-system-operations-and-control.html

14EE4802/1 – FACTS CONTROLLERS

Course Category:	Programme Elective - III	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 -1- 0
Prerequisites:	Power Electronics(14EE3602) Power System Analysis(14EE3703)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:										
	CO1	Understand necessity of various types of FACTS Devices in transmission system and analysis voltage source converter(VSC)										
	CO2	Learn principle and operation of static shunt compensators										
	CO3	Learn principle and operation series compensators										
	CO4	Acquire the concepts of multi- type FACTS controllers										
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	M	L			H		L		L			
	CO2	M	L			H		L		L			
	CO3	M	L			H		L		L			
	CO4	M	L			H		L		L			

Course Content

UNIT - I **[Text Book-1]**

FACTS Concept And General System Considerations:

Electrical Transmission Network - Necessity - Power Flow in AC System – relative importance of controllable parameters - Basic types of Flexible AC transmission system (FACTS) Controllers -opportunities for FACTS - possible benefits for FACTS.

Voltage Source Converters:

Basic concept of Voltage source converter – Three phase full-wave bridge converter – operation – Fundamental and Harmonics, Transformer Connections for 6 and 12 pulse operation – Pulse Width Modulation (PWM) Converter - Harmonic elimination and Voltage control

UNIT- II **[Text Book-1]**

Static Shunt Compensators:

Objectives of shunt compensation - Methods of controllable VAR generation – configuration and operating characteristics of Thyristor Controlled Reactor (TCR), Thyristor Switched Reactor (TSR) and Thyristor Switched Capacitor (TSC) - functional control schemes. Static Synchronous Compensator (STATCOM) – operating principle – control schemes, Comparison between STATCOM and Static var Compensator (SVC)**.**

UNIT – III **[Text Book-1]**

Static Series Compensators:

	Objectives of Series Compensation – Gate Turn Off Thyristor-Controlled Series Capacitor (GCSC), Thyristor-Switched Series Capacitor (TSSC), Thyristor-Controlled Series Capacitor (TCSC) and Static Synchronous Series Compensator (SSSC) - Operation and Control, External System Control for series Compensators, Sub Synchronous Resonance (SSR) and its damping. **UNIT– IV** **[Text Book-1]** **Multi Type FACTS Controllers**: The unified Flow Power Controller (UPFC) – Operation and control, Comparison with other FACTS devices, control of P and Q, Dynamic Performance. Generalized Unified Power Flow Controller (GUPFC) - Operation and Control, Interline Power flow Controller - Operation and Control.
Text books and Reference books	**Text Book(s):** [1] N.G.Hingorani & L.Gyugyi, "*Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems*", Wiley IEEE Press, 2013. **Reference Books:** [1] T.J.E.Miller, "*Reactive Power Control in Electric Systems*", John Wiley & sons,2010 [2] K.R.Padiyar, "*FACTS Controllers in power transmission and Distribution*", New Age Int. Publisher,2007.
E-resources and other digital material	

14EE4802/2 – COMPUTER ORGANIZATION

Course Category:	Programme Elective-III	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	Digital circuits and systems(14EE3304)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Describe Register transfer and micro operations.
	CO2	Understand the design of basic computer and control unit.
	CO3	Know the Organization and architecture of CPU.
	CO4	Apply algorithms to perform arithmetic operations on fixed point and floating point data. Understand Memory Hierarchy and I/O Organization

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H											
CO2	M	M	H									
CO3		H										
CO4	H	H			L							

Course Content

UNIT- I **[Text Book-1]**

Register Transfer and Micro-Operations:

Register Transfer Language, Register Transfer, Bus and memory Transfers, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift Unit.

Basic Computer Organization and Design:

Instruction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input-Output and Interrupt, Design of Basic Computer, Design of Accumulator Logic.

UNIT- II **[Text Book-1]**

Micro Programmed Control:

Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit.

Central Processing Unit:

General register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC)

UNIT - III **[Text Book-1]**

Computer Arithmetic:

Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating-

	point Arithmetic operations. **Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware. **UNIT- IV** **[Text Book-1]** **Input Output Organization:** Peripheral Devices, Input-output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access (DMA), Input-Output Processor,Serial Communication.
Text books and Reference books	**Text Book(s):** [1]. Morris M. Mano, *Computer Systems Architecture*. 3rd Edition, Pearson/PHI **Reference Books:** [1]. Carl Hamacher, ZvonkoVranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002. [2]. John P. Hayes, *Computer Architecture and Organization*. TMH.
E-resources and other digital material	[1]. http://www.nptel.iitm.ac.in/video.php?subjectId=106106092 [2]. http://www.nptel.iitm.ac.in/video.php?subjectId=117105078

14EE4802/3 RENEWABLE ENERGY SYSTEMS

Course Category:	Programme Elective-III	**Credits:**	3
Course Type:	Theory	**Lecture- Tutorial- Practice:**	3-1 - 0
Prerequisites:	Power Systems I (14EE3507)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Understand the basics of various Renewable Energy Systems and acquire knowledge of Bio Mass.
	CO2	Understand the concepts and acquire knowledge of Wind Energy Generation Systems.
	CO3	Acquire knowledge of Solar Radiation, Collection, Energy storage and its applications
	CO4	Know the concepts of Geo thermal, Ocean Energy and Direct Energy Conversion Systems

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	L			L			M	M			
	CO2	H	L			L			M	M			
	CO3	H	L			L			M	M			
	CO4	H	L			L			M	M			

Course Content

UNIT- I **[Text Book-1&2]**

Introduction:

Statistics on Conventional Energy Sources and Supply in Developing Countries. Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES, Classification of NCES: Biomass, Wind, Solar, Geothermal, Ocean energy sources and their comparison.

Bio-Mass:

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, utilization for cooking, I.C. Engine operation and economic aspects.

UNIT- II **[Text Book-1&2]**

Wind Energy:

Energy available from wind, General formula, Lift and drag. Basis of Wind energy conversion, Effect of density, Frequency variances, Angle of attack, Wind speed, Windmill rotors, Horizontal axis and Vertical axis rotors, Determination of torque coefficient, Induction type generators, Working principle of wind power plant, Betz criteria.

UNIT-III **[Text Book-1&2]**

Principles of Solar Radiation And Collection:

Introduction to solar energy, physics of the sun, the solar constant,

	extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data. Classification of concentrating collectors, orientation and thermal analysis (elementary treatment), advanced collectors. **Solar Energy Storage and Applications:** Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion. **UNIT- IV** **[Text Book-1&2]** **Geothermal Energy:** Definition and classification of resources, Utilization for electricity generation and direct heating, Wellhead power generating units. Basic features: Atmospheric exhaust and condensing Exhaust types of conventional steam turbines, Resources, types of wells, methods of harnessing the energy, potential in India. **Ocean Energy:** OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics. **Direct Energy Conversion:** Need for DEC, Carnot cycle, limitations, principles of DEC, Fuel cells.
Text books and Reference books	**Text Book(s):** [1] Non-Conventional Energy Sources by G.D. Rai, Khanna Publishers, 2006 [2] Renewable Energy Resources – Twidell & Wier, CRC Press(Taylor & Francis), 2012 **Reference Books:** [1] Renewable energy resources by G. N. Tiwari, M. K. Ghosal, Alpha Science International, 2005. [2] Renewable Energy Technologies by R. Ramesh, K. Uday Kumar, M. Anandakrishnan, Narosa Publishing House, 1997 [3] Non-Conventional Energy Systems by K Mittal, A. H. Wheeler Publishing Company Limited, 01-Jan-1999. [4] Renewable energy sources and emerging technologies by D.P.Kothari,K.C.Singhal, P.H.I.
E-resources and other digital material	[1] http://www.solarenergy.org/online/ [2] http://nptel.ac.in/courses/108105058/ [3] http://freevideolectures.com/Course/2352/Power-System-Generation-Transmission-and-Distribution/6 [4] http://www.nptelvideos.in/2012/11/energy-resources-and-technology.html

14EE4802/4 HIGH VOLTAGE ENGINEERING

Course Category:	**Programme Elective-III**	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	EMFT(14EE3404),Power Systems I(14EE3507), Power Systems II(14EE3604)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Elucidate the concepts used for the generation of high voltages and currents and design corresponding circuits
	CO2	Elucidate the concepts used for the measurement of high voltages and current design corresponding circuits
	CO3	Analyze high voltage testing techniques of Power apparatus and Insulation coordination in Power systems
	CO4	Know the breakdown phenomenon in various types of insulating materials and to solve electrical field problems using numerical Methods.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H						H			H		
	CO2	M						H			H		
	CO3	L						H			H		
	CO4	H						H			H		

Course Content

UNIT- I **[Text Book-1 & 2]**

Generation of High DC And AC Voltages:

Principle of Voltage Doublers circuit, Cockcroft-Walton cascade arrangement, and its mathematical analysis; cascade connection of transformers, resonant transformers, Tesla coil.

Generation of Impulse Voltages:

Standard specifications, standard wave shapes for testing, properties of double exponential wave shapes, approximate estimate of wave shape control resistors, Multistage impulse generator, Energy of impulse generator.

Generation of Impulse Currents:

Standard specifications, analysis of impulse current generator.

UNIT- II **[Text Book-1 & 2]**

Measurement of High Voltages and Currents:

DC, AC and impulse voltages and currents-CRO/DSO electrostatic and peak voltmeters-sphere gaps-factors affecting measurements-potential dividers - series impedance ammeters- Rogowski coils-Hall effect generators, Digital techniques in HV

	measurements. **UNIT- III** **[Text Book-1]** **High Voltage Testing Techniques:** Testing of insulators, transformers, lightning arresters, bushings, Power cables, circuit breakers and isolators. **Insulation Coordination:** Principle of insulation coordination on high voltage and extra high voltage power systems. **UNIT- IV** **[Text Book-1 & 2]** **Breakdown of Insulators - Solid, Liquid and Gasses Dielectrics:** Introduction to solid, liquid and gaseous dielectrics. Breakdown of solid, liquid, amorphous, gasses and gas mixtures dielectrics - breakdown in uniform and non-uniform fields- Paschen's law-Townsend's criterion-streamer mechanism-corona discharge-breakdown in electro negative gases.
Text books and Reference books	**Text Book(s):** [1] Naidu M. S. and Kamraju V., "*High voltage Engineering*",. TMH publications 5th edition.,2012 [2] C.L. Wadhwa, "*High voltage Engineering*",. New Age International, 01-Jan-2007 **Reference book:** [1] E. Kuffel, W. S. Zaengl and J. Kuffel., "*High Voltage Engineering Fundamentals*", 2nd edition , Elsevier Publication,2005 [2] Naidu M.S., "*Gas Insulated Substations*", I.K International Publishing House Pvt. Ltd.2008
E-resources and other digital material	http://nptel.ac.in/courses/108104048/ui/TOC.htm

14EE4803/1 ADVANCED POWER SYSTEM PROTECTION

Course Category:	Programme Elective-IV	**Credits:**	3
Course Type:	Theory	**Lecture- Tutorial- Practice:**	3-1-0
Prerequisites:	Switchgear and Protection(14EE3702)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Elucidate various microprocessor based relays.
	CO2	Understand basic Static relays and its operation.
	CO3	Know various static protection schemes of transmission lines & Transformers.
	CO4	Acquire Knowledge of various Digital relays and its operation.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1			H							M		
	CO2										M		
	CO3										H	M	
	CO4	H										H	

Course Content

UNIT- I **[Text Book – 1&2]**

Basics of Electromagnetic Relays their advantages and disadvantages. Microprocessor Based Relays: Over Current relay, impedance relay, directional relay, reactance relay, Mho relay, offset Mho relay.

UNIT- II **[Text Book – 1&2]**

Static protection of transmission lines - Pilot relaying and Carrier current protection schemes – 3–zone protection schemes – carrier aided distance schemes. Static Harmonic Restraint relay for transformer protection.

UNIT- III **[Text Book – 1]**

Digital relays - Developments in computer relaying mathematical basis for protective relaying algorithms, Differential equation based technique; Fourier based algorithms, Basics of Numerical Over current,distance, and differential protection systems.

UNIT – IV **[Text Book – 1]**

Artificial Intelligence (AI) based Numerical Protection: Application of ANN to over current protection, Transmission line protection. Neural Networks based Directional Relay. Power transformer protection based on ANN &

	Fuzzy logic.
Text books and Reference books	**Text Book(s):** [1] Power System Protection and Switchgear 2/e, Badri Ram, TMH. [2] Power System Protection – Static relays T.S.Madhava Rao, TMH, 2010. **Reference Books:** [1] Digital Protection for Power Systems A.T.Johns and S.K.Salman, 1995.
E-resources and other digital material	[1] www.nptel.ac.in/courses/108101039/20 [2] https://library.e.abb.com/.../Reprint%20%20ABB%20review%203_2011_lowres.pdf

14EE4803/2 – ENERGY CONSERVATION AND AUDIT

Course Category:	Programme Elective-IV	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course Outcomes		Upon successful completion of the course, the student will be able to:
	CO1	**Understand** the concepts of energy audit, instruments
	CO2	**Analyze** depreciation methods and Energy efficient motor controls.
	CO3	**Analyze** energy efficient transformers and reactive power management.
	CO4	**Analyze** demand side management.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M									
CO2	M		H		H							
CO3	M		H		H							
CO4	M		M									

Course Content

UNIT- I **[Text Book – 1]**

Energy Audit:

Definitions-Need-concepts-Types of energy audit; audit instruments, Energy index – cost index – pie charts – Sankey diagrams. System approach, end use approach to efficient use of Electricity; Specific energy analysis, Minimum energy paths, consumption models, Energy auditing of a typical industrial unit - case study

UNIT- II **[Text Book – 2]**

Energy Economics:

Introduction-Cost benefit risk analysis-Payback period-Straight line depreciation-Sinking fund depreciation—Reducing balance depreciation-Net present value method-Internal rate of return method-Profitability index for benefit cost ratio.

Electric motors:

Energy efficient controls and starting efficiency, motor efficiency and Load analysis, Energy efficient/high efficient Motors; Load Matching and selection of motors. Variable speed drives.

UNIT- III **[Text Book - 2]**

Energy efficient transformers, Transformer Loading/Efficiency analysis, feeder/cable loss evaluation, case studies.

Reactive power management:

Capacitor Sizing, Degree of Compensation, Capacitor losses, Location-placement-Maintenance, case studies; Peak Demand control methodologies, types of Industrial

	loads, optimal Load scheduling, case studies; **UNIT- IV** **[Text Book –1 & 2]** Introduction to Demand Side Management, Concept of DSM, Benefits of DSM, Different Techniques of DSM – Time of Day Pricing, Multi-Utility Power Exchange Model, Time of Day Models for Planning Load Management, Load Priority Technique, Peak Clipping, Peak Shifting, Valley Filling, Strategic Conservation, Energy Efficient Equipment. Management and Organization of Energy Conservation Awareness Programs
Text books and Reference books	**Text Book(s):** [1] Wayne C.Turner, "Energy management Hand book", 8th ed., John Wiley and son. [2] S.C. Tripathy, Electric "Energy Utilization and Conservation", Tata McGraw Hill, 1991. [3] Arry C. White, Philip S. Schmidt, David R. Brown, "Industrial Energy Management Systems", Hemisphere Publishing Corporation, New York, 1994. **Reference Books:** [1] John C. Andreas, "Energy efficient electric motors selection and application". [2] Amit kumar Tyagi, "Hand book on Energy Audit and Management", TERI(Tata energy research Institute). [3] Paul W.O. Callaghan, "Energy Management", McGraw hill Book Company. [4] Rakosh Das Begamudre, "Energy conversion systems", xth ed., new age international publishers. [5] W.R.Murphy & G.Mckey Butterworths, "Energy Management", new age international publishers). [6] Kurose and Ross, "*Computer Networks – A Top-down Approach Featuring the Internet",* 'Pearson Education. [7] Economic Analysis of Demand Side Programs and Projects – California Standard Practice Manual, June 2002 – Free download available online.
E- resources and other digital material	**BEE Reference book: no.1/3/4.** www.bee-india.com

14EE4803/3 – ELECTRICAL MACHINE DESIGN

Course Category:	Programme Elective - IV	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1 - 0
Prerequisites:	D.C. Machines(14EE3305), Transformers and Induction Motors(14EE3405) , Synchronous and Special Machines (14EE3504).	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Understand the basic concepts of machine design parameters, factors influencing temperature raise and cooling methods.
	CO2	Design armature and field systems for D.C. machines.
	CO3	Design the main dimensions of Transformers, Induction machines.
	CO4	Design the main dimensions of synchronous machines.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H					H					
CO2	H	H	H				H		L		M	
CO3	H	H	H				H		L		M	
CO4	H	H	H				H		L		M	

Course Content

UNIT- I **[Text Book -1&2]**

Introduction:

Basic concepts of design - limitation in design – standardization - modern trends in design and Manufacturing techniques - Classification of insulating materials - Modes of heat dissipation & temperature rise- time curves - Methods of cooling ventilation (induced & forced, radial & axial), direct cooling and quantity of cooling medium - Calculation of total mmf and magnetizing current - Specific permeance and leakage reactance.

UNIT- II **[Text Book -1&2]**

D.C. Machines:

E.M.F generated from full pitch - fractional pitch with and without distributed windings - distribution factor. Design of main dimensions from output equation - Design of Armature windings - Design of field system – Design of interpoles and commutator**.**

UNIT - III **[Text Book -1&2]**

Transformers:

Derivation of output equation - volt per turn importance and calculation of main dimensions for three phase and single phase transformers - window dimensions - Yoke and coil design - Design of tank with tubes.

	Induction Motors: Output equation - calculation of main dimensions – Stator design - number of slots - Design of rotor bars & slots - Rotor design for squirrel cage and slip ring type induction motors. **UNIT – IV** **[Text Book -1&2]** **Synchronous Machines:** Derivation of output equation - Calculations of Main Dimensions for salient pole and cylindrical rotor alternators - Stator design - number of stator slots and slot dimensions - Pole design for salient pole generators - pole winding calculations. Design of rotor for cylindrical rotor alternator - Design of rotor windings.
Text books and Reference books	**Text Book(s):** [1] A Course in Electrical machine Design by A.K. Sawhney, Dhanpatrai& Sons [2] Performance and Design of AC Machines by M.G. Say **Reference Books:** [1] Performance and Design of AC Machines by A.E. Clayton [2] A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age Intenational Pvt. Ltd. [3] Design of Electrical Machines K G Upadhyay
E-resources and other digital material	

14EE4803/4: SMART GRID TECHNOLOGY

Course Category:	Programme Elective - IV	**Credits:**	3
Course Type:	Theory	**Lecture- Tutorial- Practice:**	3 -1 - 0
Prerequisites:	None	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 M 70M 100M

Course outcomes		Upon successful completion of the course, the student will be able to:
	CO1	Understand the basics of Smart Grid architecture and its components.
	CO2	Understand the Information & Communications Technology for The Smart Grid
	CO3	Acquire Knowledge about Sensing and Measurement technologies and related measuring unit in Smart Grid.
	CO4	Know the concept of Smart metering and demand-side integration.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H			M		L						
CO2				H								
CO3	M	H									M	
CO4				H		H		H				

Course Content

UNIT- I **[Text Book -1]**

Smart Grid Architectural Designs :

Introduction – Comparison of Power grid with Smart grid – power system enhancement – communication and standards - General View of the Smart Grid Market Drivers - Stakeholder Roles and Function - Measures - Representative Architecture - Functions of Smart Grid Components.

UNIT - II **[Text Book -2]**

Information and Communications Technology for the Smart Grid :

Data communication: Introduction, Dedicated and shared communication channels, Switching techniques, Communication channels, Layered architecture and protocols.

Communication technologies for the Smart Grid:

Introduction- Communication technologies-IEEE 802 series, Mobile communications, Multi-protocol label switching, Power line communication. Standards for information exchange-Standards for smart metering Modbus, DNP3, IEC 61850.

Information security for the Smart Grid:

Encryption and decryption, authentication, Digital signatures, Cyber security standards.

UNIT - III **[Text Book -1]**

Sensing and Measurement:

Monitoring, PMU, Smart Meters, and Measurements Technologies -Wide Area

	Monitoring Systems (WAMS), Phasor Measurement Units (PMU), Smart Meters, Smart Appliances, Advanced Metering Infrastructure. GPS and Mapping Tools. Multi Agent Systems (MAS) Technology. **UNIT-IV** **[Text Book -2]]** **Smart metering and demand-side integration:** Introduction, Smart metering-Evolution of electricity metering, Key components of smart metering, Smart meters- An overview of the hardware used, Communications infrastructure and protocols for smart metering, Demand-side integration.
Text books and Reference books	**Text Book(s):** [1] Janaka Ekanayake, Kithsiri Liyanage, Jianzhong.Wu, Akihiko Yokoyama, Nick Jenkins, "*Smart Grid: Technology and Applications*"- Wiley, 2012. [2] James Momoh, "*Smart Grid: Fundamentals of Design and analysis*"- Wiley, IEEE Press, 2012. **Reference Books:** [1] Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009
E-resources and other digital material	

14EE4851- SIMULATION OF ELECTRICAL SYSTEMS LABORATORY

Course Category:	**Laboratory**	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 0 - 3
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes		Upon successful completion of the course, the student will be able to:											
	CO1	Design and conduct experiment.											
	CO2	Analyze and present experimental results.											
	CO3	Exhibit professional behavior											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1		M		H								
	CO2				H			H					
	CO3				H			M					

Course Content

LIST OF EXPERIMENTS:

1. Modeling of Transmission lines
2. Speed Control of Three phase Induction machine
3. Simulation of Three phase rectifier with R & R-L, R-L-E loads
4. Simulation of three-phase inverter
5. Transient Analysis of Electrical system
6. Fault analysis of a simple power AC system
7. Simulation of 3-phase power system network for different loads
8. Simulation of single area Load Frequency Control
9. Step response of second order Transfer function for different damping factors
10. Representation of Transfer function from Block diagram
11. Economic dispatch
12. Voltage stability analysis
13. Load flow studies
14. Short circuit studies in power systems
15. Steady state stability analysis of power systems

Note: A minimum of 10 (Ten) experiments have to be completed to attain eligibility for Practical Examinations.