Velagapudi Ramakrishna

Siddhartha Engineering College: Vijayawada-7

Electronics and Communications Engineering(ECE)

Scheme of Instruction and Examination-VR14

Semester I

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	To
1	14MA1101	Linear Algebra and Differential Equations	4	1		4	30	70	100
2	14PH1102	Engineering Physics	3	1		3	30	70	100
3	14CS1103	Introduction to Computing	2			2	30	70	100
4	14HS1104	Technical English and Communication Skills	2		2	2	30	70	100
5	14EE1105	Basics of Electrical Engineering	2			2	30	70	100
6	14ME1106	Basics of Mechanical Engineering	2			2	30	70	100
7	14PH1151	Engineering Physics Lab	2		6	5	30	70	100
8	14CS1152	Basic Computing Lab			3	2	30	70	100
9	14ME1153	Engineering Graphics			3	2	30	70	100
			17	2	14	24	270	630	900

Semester II

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	To
1	14MA1201	Calculus	4	1		4	30	70	100
2	14CH1202	Engineering Chemistry	3	1		3	30	70	100
3	14CS1203	Programming in C	3	1		3	30	70	100
4	14CE1204	Basics of Civil Engineering	2			2	30	70	100
5	14HS1205	Professional Ethics	2			2	30	70	100
6	14EC1206	Basics of Electronics Engineering	2			2	30	70	100
7	14ME1207	Mechanics for Engineers	4	1		4	30	70	100
8	14CH1251	Engineering Chemistry Lab			3	2	30	70	100
9	14CS1252	C Programming Lab			3	2	30	70	100
10	14ME1253	Workshop Practice			3	2	30	70	100
			20	4	9	26	300	700	1000

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

Velagapudi Ramakrishna

Siddhartha Engineering College: Vijayawada-7

Electronics and Communications Engineering(ECE)

Scheme of Instruction and Examination-VR14

Semester III

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	To
1	14MA1301	Complex Analysis and Numerical Methods	4	1		4	30	70	100
2	14EC3302	Electronic Devices	4			4	30	70	100
3	14EC3303	Network Theory	3	1		3	30	70	100
4	14EC3304	Digital Circuits and Systems	4			4	30	70	100
5	14EC3305	Signals and Systems	3	1		3	30	70	100
6	14EC3306	Electrical Technology	2			2	30	70	100
7	14EC3351	Electronic Devices and Digital Circuits Lab			3	2	30	70	100
8	14EC3352	Electrical Technology Lab			3	2	30	70	100
9	14HS1353	Communication Skills Lab				2	30	70	100
			20	3	6	26	270	630	900

Semester IV

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	To
1	14EC3401	Probability Theory and Random Processes	4	1		4	30	70	100
2	14EC3402	Electronic Circuits	4			4	30	70	100
3	14EC3403	Electromagnetic Field Theory	4	1		4	30	70	100
4	14HS1404	Environmental Studies	3			3	30	70	100
5	14EC3405	Computer Architecture and Organization	3			3	30	70	100
6	14EC3406	Analog Communications	4			4	30	70	100
7	14EC3451	Electronic Circuits Lab			3	2	30	70	100
8	14EC3452	Analog Communications Lab			3	2	30	70	100
			22	2	6	26	240	560	800

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

Velagapudi Ramakrishna

Siddhartha Engineering College: Vijayawada-7

Electronics and Communications Engineering(ECE)

Scheme of Instruction and Examination-VR14

Semester V

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	To
1	14EC3501	Linear Control Systems	4			4	30	70	100
2	14EC3502	Pulse and Switching Circuits	3	1		3	30	70	100
3	14EC3503	Microprocessors and Microcontrollers	3	1		3	30	70	100
4	14EC3504	Digital Communications	3	1		3	30	70	100
5	14EC2505	Institutional Elective	4			4	30	70	100
6	14EC5506	Independent Learning(MOOCS)				2	30	70	100
7	14EC3507	Transmission lines and Wave guides	3	1		3	30	70	100
8	14EC3551	Pulse and Switching Circuits Lab			3	2	30	70	100
9	14EC3552	Digital Communications Lab			3	2	30	70	100
			20	4	6	26	270	630	900

Semester VI

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	To
1	14EC3601	Linear Integrated Circuits and Applications	4			4	30	70	100
2	14EC3602	Computer Networks	3			3	30	70	100
3	14EC3603	Antennas and Wave Propagation	3			3	30	70	100
4	14EC3604	VLSI Design	4			4	30	70	100
5	14EC3605	Digital Signal Processing	3			3	30	70	100
6	14EC3651	Linear Integrated Circuits and Applications Lab			3	2	30	70	100
7	14EC3652	VLSI Design Lab			3	2	30	70	100
8	14EC5653	Term Paper		1		2	30	70	100
			17	1	6	23	240	560	800

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

Velagapudi Ramakrishna

Siddhartha Engineering College: Vijayawada-7

Electronics and Communications Engineering(ECE)

Scheme of Instruction and Examination-VR14

Semester VII

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	To
1	14EC3701	Electronic Measurements and Instrumentation	3			3	30	70	100
2	14EC3702	Cellular and Mobile Communications	3			3	30	70	100
3	14EC3703	DSP Processors and Architectures	4			4	30	70	100
4	14HS1704	Engineering Economics and Finance	3			3	30	70	100
5	14EC4705	Program Elective I	4			3	30	70	100
6	14EC4706	Program Elective II	4			3	30	70	100
7	14EC3751	DSP Lab			3	2	30	70	100
8	14EC3752	Microprocessors and Microcontrollers Lab			3	2	30	70	100
9	14EC6753 \ 14EC6754	Internship Industry Offered Course			2	2	-	100	100
10	14EC5755	Mini Project		1		2	30	70	100
			21	1	8	27	270	730	1000

Program Elective-I
14EC4705/1: Optical Communication
14EC4705/2: Satellite Communication
14EC4705/3: Digital Television
14EC4705/4: Adhoc Networks
14EC4706/5: Embedded Systems using RTOS

Program Elective-II
14EC4706/1: Speech Processing
14EC4706/2: Image Processing
14EC4706/3: Biomedical Signal Processing
14EC4706/4: Open

Velagapudi Ramakrishna

Siddhartha Engineering College: Vijayawada-7

Electronics and Communications Engineering(ECE)

Scheme of Instruction and Examination-VR14

Semester VIII

S.No	Sub. Code	Subject Title	L	T	P	C	CE	SE	To
1	14EC3801	Microwave Engineering	4			4	30	70	100
2	14EC4802	Program Elective III	4			3	30	70	100
3	14EC4803	Program Elective IV	4			3	30	70	100
4	14EC3851	Microwave Engineering Lab			3	2	30	70	100
5	14EC5852	Major Project		6	6	10	30	70	100
			12	6	9	22	150	350	500

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

Program Elective-III

14EC4802/1: Semiconductor Device Modeling

14EC4802/2: Low power VLSI

14EC4802/3: Analog and Digital IC Design

14EC4802/4: Embedded Systems using Embedded Linux

Program Elective-IV

14EC4803/1: RADAR and Navigational Aids

14EC4803/2: Advanced wireless Communications

14EC4803/3: EMI & EMC

14EC4803/4: Industry Need Based

14MA1101: LINEAR ALGEBRA AND 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:**	30 70 100

<table>
<tr><td rowspan="5">Course outcomes</td><td colspan="12">Upon successful completion of the course, the student will be able to:</td></tr>
<tr><td>CO1</td><td colspan="11">Understand the concept of eigen values and eigen vectors and able to reduce a quadratic form to canonical form.</td></tr>
<tr><td>CO2</td><td colspan="11">Able to solve the linear differential equations by using appropriate methods.</td></tr>
<tr><td>CO3</td><td colspan="11">Able to form Partial Differential equations and solve Partial Differential equations.</td></tr>
<tr><td>CO4</td><td colspan="11">Understand the concepts of Laplace Transforms and able to apply to solve Differential Equations, Integral Equations by Transform method.</td></tr>
<tr><td rowspan="5">Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)</td><td></td><td>PO a</td><td>PO b</td><td>PO c</td><td>PO d</td><td>PO e</td><td>PO f</td><td>PO g</td><td>PO h</td><td>PO i</td><td>PO j</td><td>PO k</td><td>PO l</td></tr>
<tr><td>CO1</td><td>H</td><td>L</td><td></td><td></td><td>H</td><td></td><td></td><td></td><td></td><td></td><td>L</td><td></td></tr>
<tr><td>CO2</td><td>H</td><td>M</td><td></td><td></td><td>H</td><td></td><td></td><td></td><td></td><td></td><td>L</td><td></td></tr>
<tr><td>CO3</td><td>H</td><td>M</td><td></td><td></td><td>H</td><td></td><td></td><td></td><td></td><td></td><td>L</td><td></td></tr>
<tr><td>CO4</td><td>H</td><td>H</td><td></td><td></td><td>H</td><td></td><td></td><td></td><td></td><td></td><td>L</td><td></td></tr>
<tr><td>Course Content</td><td colspan="12">UNIT I:

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:

Differential Equations of First Order: Formation of a Differential Equation, Solution of a Differential Equation, Linear Equations,</td></tr>
</table>

	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:** 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** **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:** 1. B.S.Grewal, "Higher Engineering Mathematics", Khanna Publishers; 42nd Edition, 2012. **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

14PH1102: ENGINEERING PHYSICS

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

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	Analyse and understand semiconductor technology and various types of lasers & optical fibers.
	CO4	Understand the fabrication of nanomaterials, carbon nanotubes and their applications in various fields

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	POf	PO g	PO h	PO i	PO j	PO k	POl
	CO1	H	M					M				L	L
	CO2	H	M	L	M							M	H
	CO3	H		M	M							M	H
	CO4	H	M	L			L					M	H

Course Content	**UNIT - I** **Quantum Mechanics:** Dual nature of light, Matter waves and Debroglie's hy-pothesis, 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 Schrodinger'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** **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** **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 **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.
Text books and Reference books	**Text Book:** 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 6. http://freevideolectures.com/Course/3048/Physics-of-Materials/36

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:**	30 70 100

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)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L	M										
	CO2	M											
	CO3	M	L	L		M							
	CO4		L			L							
	CO5	M	M	L		L							

Course Content

UNIT - I

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** **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** **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** **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	**Textbooks** 1. Peter Norton, "Introduction to Computers", 6th Edition, Tata McGraw Hill. 2. Reema Thareja, "Computer Fundamentals and C Programming".
E-resources and other digital material	1. Lecture Series on Computer Organization by Prof. S. Raman, Department of ComputerScienceandEngineering,IITMadras https://www.youtube.com/watch?v=leWKvuZVUE8 2. Lecture Series on Data Communication by Prof.A. Pal, Department of ComputerScienceEngineering,IITKharagpur. https://www.youtube.com/watch?v=sG6WGvzmVaw

14HS1104: TECHNICAL ENGLISH AND COMMUNICATION SKILLS

Course Category:	Programme 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:**	30 70 100

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 skills											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		POa	POb	POc	POd	POe	POf	POg	POh	PO i	POj	POk	PO l
	CO1						H	M	H	M	H	M	M
	CO2						H	H	H	M	H	M	M
	CO3	M				L	H	M	H	M	H	H	M
	CO4				M	L	H	H	H	M	H	M	M
	CO5	L	L	L	L	L	H	H	H	M	H	H	M

Course Content	**UNIT - I**: **Professional Writing Skills** 1. Professional Letters-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** Communicative Facet- Speech acts- Extending Invitation, Reciprocation, Acceptance, Concurrence and Disagreeing without being disagreeable Articulation-oriented Facet- Phonetic Transcription using IPA symbols with Vowel and Consonant charts - Word Stress. **UNIT - III: Vocabulary and Functional English** 1. A basic List of 500 words - Overview 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)
Text books and Reference books	**Textbooks** 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" Poosha Series, 4th edition, 2008. 4. Eclectic Learning materials offered by the Department **Reference Books** 1. Randolph Quirk, "Use of English", Longman, I Edition(1968) Reprinted. 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 Paperback 1971(Reprint) 2010. 4. John Langan, "College Writing Skills", McGraw Hill,9th 2004. 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. J.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.cambridgeapps.org/ up dated 2014

14EE1105: BASICS OF ELECTRICAL ENGINEERING

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

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Analyze D.C circuit in steady state.											
	CO2	Understand the basic concepts of Electromagnetism.											
	CO3	Analyze 1-ph a .c. circuits in steady state.											
	CO4	Understand measuring instruments & domestic wiring.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	M			M			a					
	CO2	M			M			M					
	CO3	L						M					
	CO4	L						M					
Course Content	**UNIT - I** **D.C. Circuits:** Definitions:- charge, current, voltage power, energy;. Ohm's law and its limitation; Resistances in series, parallel, current division in parallel and voltage division in series circuits; Kirchhoff's laws and its applications; Analysis of series, parallel and series-parallel resistive, inductive and capacitive circuits excited by independent voltage sources; Power and Energy in such circuits. **UNIT - II** **Electromagnetism:** Concept of magnetic circuits, Reluctance, Magnetic field due to steady electric current, Magnetic flux, Flux density and magnetic field intensity, Interaction of currents and fields, AC excitation of magnetic circuit, B-H curve, Calculation of Magnetic Circuits, Iron Losses, Leakage flux; Faraday's laws, Lenz's law, Fleming's rules; Statically and Dynamically induced E.M.F.'s; Concept of self, mutual inductance and coefficient of coupling; Coupled circuits;												

	Energy stored in magnetic field. **UNIT - III** **Single Phase A.C Circuits:** Generation of sinusoidal AC voltage; Definition of average value, R.M.S value, form factor, peak factor; Concept of Phase and phase difference of sinusoidal varying voltage and current; Phasor representation of alternating quantities; Definition of real power, reactive power, apparent power and power factor. **UNIT - IV** **Measuring Instruments and Domestic Wiring:** Classification of instruments; Principal of operation; Operating torques in indicating instruments; Classification of meters; Errors in meters; Power rating for appliances; Two-way position control of a lamp. Elementary discussion on fuses; Necessity and types of earthing; Electric shock and precautions against it.
Text books and Reference books	**Textbooks** 1. I.J.Nagrath and Kothari, "Theory and Problems of Basic Electrical Engi-neering ", Prentice-Hall of India Pvt. Ltd. 2. Dr. K. Uma Rao, Dr. A. Jayalakshmi, "Basic Electric Engineering", Pearson Publications. 3. T.K. Nagasarkar and M.S. Sukhja, "Basic Electric Engineering", Oxford University press. **Reference Books** 1. U.A.Bakshi, V.U.Bakshi, "Basic Electrical Engineering", Technical Publications.
E-resources and other digital material	1. http://www.textbooksonline.tn.nic.in/books/11/stdxi-voc-ema-em-1.pdf 2. http://nptel.ac.in/courses/108108076/

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:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand the basic manufacturing methods and power transmission in mechanical engineering.											
	CO2	Attain basic knowledge of simple stress and strains.											
	CO3	Realize the importance of energy and identify various sources of energy.											
	CO4	Understand the principle of operation of different IC engines and their applications.											
	CO5	Describe the performance of different types of refrigeration systems											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H			M			M					
	CO2	H			M	H							
	CO3	H			H								
	CO4	H			H			H					
	CO5	H			M			M					
Course Content	**UNIT - I** **Manufacturing Methods:** **CASTING**:- Principles of casting , Advantages and applications of casting , green sand mould. **LATHE:** Description, Main components , Basic operations performed on a Lathe (turning, thread cutting, taper turning, drilling)												

	WELDING: Types, Equipments, Principles of Gas welding and Arc Welding, Applications, Advantages & disadvantages of welding , Brazing and soldering. **UNIT - II** **Simple STRESS and STRAIN:** Stress and Strain Elasticity and Hook's Law-Relations between elastic constants. **POWER TRANSMISSION: Belt Drives** :- Introduction , Types , Length of open belt drive and cross belt drive , velocity ratio and difference between Open belt drive and cross belt drive , power transmitted by belt. **UNIT - III** **ENERGY RESOURCES:** **Conventional Energy Resources:-** Energy scenario ,types of sources , 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 power plant. **UNIT - IV** **INTERNAL COMBUSTION ENGINES:** Classification, Main components of I.C. Engine, Working principle of Two stroke and four stroke petrol, engine and diesel engine. **REFRIGERATION:** Types of refrigeration, Unit of refrigeration , COP, Working of vapour compression Refrigeration system , applications.
Text books and Reference books	**Textbooks** 1. T S Rajan, "Basic Mechanical engineering", 3rd Edition, New Age International Ltd., First Reprint 1999. 2. R.S Khurmi , J.K . Gupta , "Machine Design", Eurasia publications House, 2005. 3. T.J.Prabhu, V.Jaiganesh, S.Jebaroj, "Basic Mechanical Engineering", SCI Tech Publications (India) Pvt. Ltd.

	Reference Books: 1. R Rudramoorthy, " Thermal Engineering", 4th Reprint, 2006 ,Tata McGraw-Hill publishing Company Ltd., New Delhi. 2. R.K . Rajput, "Manufacturing process" , FireWall media , 2007. 3. P.K.Nag, "Power Plant Engineering", 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

14PH1151: ENGINEERING PHYSICS LAB

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

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 in the later studies											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1			H	H								M
	CO2		M			M							
	CO3			H									M
Course Content	**LIST OF EXPERIMENTS** 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 func-tion. 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:** 1. Indu Prakash & Rama Krishna, "A text book of practical physics", Vol 1,Kitab Mahal Publishers, Allahabad, 25th edition, 2003. 2. J.C.Mohanty & D.K.Mishra ,Kalyani, "University Practical Physics by Publishers", Delhi , First Edition, 1990. 3. D.P.Khandelwal, "A laboratory manual of Physics", Vani educational books, Delhi First Edition, 1991 4. Dr.Y.Aparna & Dr.K.Venkateswara Rao, "Laboratory manual of engineering physics, VGS Publications, Vijayawada, First Edition 2010.
E-resources and other digital material	1. http://plato.stanford.edu/entries/physics-experiment/ 2. http://www.physicsclassroom.com/The-Laboratory 3. http://facstaff.cbu.edu/~jvarrian/physlabs.html

14CS1152: BASIC COMPUTING LAB

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

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)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L	M										
	CO2	M											
	CO3	M	L	L		M							
	CO4		L			L							
	CO5	M	M	L		L							

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: i. Create a presentation using themes. ii. Save, edit, print and import images/videos to a presentation. iii. Adding animation to a presentation. 4. MS Access: i. Create simple table in MS Access for results processing. ii. Create a query table for the results processing table. iii. Create a form to update/modify the results processing table. iv. 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 (graph-ics, 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 po-sitions 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. 8. Configure BIOS setup program to change standard and advanced settings to troubleshoot typical problems. 9. Install and configure Printer/Scanner/Web cam/Cell phone/bio-metric device with system. Troubleshoot the problems **CYCLE - III** 1. Prepare an Ethernet/UTP cable to connect a computer to network switch. Crimp the 4 pair cable with RJ45 connector and with appro-priate color code. 2. Manually configure TCP/IP parameters (Host IP, Subnet Mask and Default Gateway) for a computer and verify them using IPCONFIG command. Test connectivity to a server system using PING com-mand. 3. Creating a shared folder in the computer and connecting to that folder using Universal Naming Convention (UNC) format. (Ex: computername sharename) 4. Configure a computer to connect to internet (using college internet settings) and troubleshoot the problems using PING, TRACERT and NETSTAT commands. 5. Using scan disk, disk cleanup, disk Defragmenter, Virus Detection and Rectifying Software to troubleshoot typical computer problems. 6. Configure DNS to establish interconnection between systems and describe how a name is mapped to IP Address.
E-resources and other digital material	1. Prof.P.B.Sunil Kumar, "Numerical Methods and Programing", Department of Physics, IIT Madras https://www.youtube.com/watch?v=zjyR9eN1D4&list=PLC5DC6AD60D798FB7 2. Introduction to Coding Concepts, Instructor: Mitchell Peabody. View the complete course: http://ocw.mit.edu/6-00SCS11

14ME1153: ENGINEERING GRAPHICS

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

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)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	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, Dimensioning, 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 * 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, Cylinders and Cones. True shapes of sections. (Limited to the Section Planes perpendicular 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 positions **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	**Textbooks** 1. N.D. Bhatt & V.M. Panchal, "Elementary Engineering Drawing" Charotar Publishing House, Anand, 49th Edition, 2006.

books	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	1. http://www.youtube.com/watch?v=XCWJ_XrkWco 2. http://www.me.umn.edu/courses/me2011/handouts/drawing /blanco tutorial.html# isodrawing 3. http://www.slideshare.net 4. http://edpstuff.blogspot.in

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:**	30 70 100

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		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H			M	M						L	
	CO2	H			M	M						L	
	CO3	H			M	M						L	

Outcomes (L – Low, M -Medium, H – High)	CO4	H			M	M						L	
Course Content	**UNIT - I** **Differential Calculus:** Rolle's Theorem, Lagrange's Mean Value Theo-rem, Cauchy's Mean Value Theorem, Taylors Theorem, Maclaurins Se-ries, Taylor's Theorem for Function of Two Variables, Curvature, Radius of Curvature. **UNIT - II** Asymptotes, Curve Tracing, Maxima and Minima of Functions 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** **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 Functions, Error Function or Probability Integral. **UNIT - IV** **Vector Calculus:** Scalar and Vector Point Functions, Del Applied to Scalar point Functions, Gradient, Del Applied to Vector point Functions, Phys-ical 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	**Textbooks** 1. B.S.Grewal, "Higher Engineering Mathematics", 42th Edition, Khanna Publishers; 2012. **Reference Books**												

	1. Krezig, "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

14CH1202: ENGINEERING CHEMISTRY

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

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		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1		H										
	CO2	M											

Outcomes (L – Low, M -Medium, H – High)	CO3					H							
	CO4			M									
Course Content	**UNIT - I** **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 condition-ing methods - phosphate, calgon and sodium aluminate - External treatment methods - zeolite and ion-exchange methods. **UNIT - II** **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** **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** **Polymer technology:** Polymerization - Addition and condensation, thermo-plastics and thermo settings - 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	**Textbooks** 1. P.C. Jain, "Engineering Chemistry", 15th edition, Dhanpat Rai 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. Shashi Chawla, "A text book of Engineering Chemistry", Dhanpat Rai & Company Pvt. Ltd., New Delhi. 3. Sunita Rattan, "A Textbook of Engineering Chemistry" , First edition 2012, S.K. Kataria & Sons, New Delhi.

	4. B.S. Bahl, G. D. Tuli and Arun Bahl, "Essentials of Physical Chemistry", S. Chand and Company Limited, New Delhi. 5. Y.Anjaneyulu, K. Chandrasekhar and Valli Manickam, "Text book of Analytical Chemistry", 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

14CS1203: PROGRAMMING IN C

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

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

Contribution of Course Outcomes		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	M											

towards achievement of Program Outcomes (L – Low, M - Medium, H – High)	CO2		M			M							
	CO3		M										
	CO4	L											
	CO5	L	M			M							
Course Content	**UNIT - I** **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** **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, Scope. **Strings:** String Concepts, C Strings, String Input/Output Functions, Arrays of Strings, String Manipulation Functions, String- Data Conversion. **UNIT - III** **Pointers:** Introduction, Pointers For Inter Function Communications, Pointers to Pointers, Compatibility, L value and R value. **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** **Enumerations:** The Type Definition (Typedef), Enumerated Types: Declaring an Enumerated Type, Operations on Enumerated Types, Enumeration Type Conversion, Initializing Enumerated Constants, Anonymous Enumeration: Constants, Input/Output Operators. **Structures:** Structure Type Declaration, Initialization, Accessing Structures, Operations on 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.
Text books and Reference books	**Textbooks** 1. Behrouz A. Forouzan & Richard F. Gilberg , "Computer Science A Structured Programming Approach using C" ,Third Edition, CENGAGE Learning. **Reference Book** 1. Balagurusamy, "Programming in ANSI" C4ed.: TMH, 2009 2. B. Gottfried, "Programming with C" (Schaum's Outlines) Tata Mcgraw-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	

14CE1204: 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:**	30 70 100

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 various types of surveying and various types of transportation systems.											
	CO4	Attain basic knowledge on water supply, sewage.											
Contribution of Course		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l

<table>
<tr><td rowspan="4">Outcomes towards achievement of Program Outcomes

(L – Low, M -Medium, H – High)</td><td>CO1</td><td>H</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td>H</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td>H</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td>H</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Course Content</td><td colspan="13">UNIT - I

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

UNIT - II

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

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

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.</td></tr>
<tr><td>Text books and Reference</td><td colspan="13">Textbooks

1. Raju .K.V.B, Ravichandran .P.T, “Basics of Civil Engineering”, Ayyappa Publications, Chennai, 2012.</td></tr>
</table>

books	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, Chartor Publishing House, Arand, 2012
E-resources and other digital material	1. ncees.org/exmas/fe-exma/ 2. www.aboutcivil.com/

14HS1205: PROFESSIONAL ETHICS

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

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Know the moral autonomy and uses of ethical theories.											
	CO2	Understand morals, Honesty & character.											
	CO3	Understand about safety, risk and professional rights.											
	CO4	Know the Ethics regarding Global Issues like Environment, Computers & weapon's development.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M -Medium, H – High)**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	M											
	CO2							M					
	CO3												M
	CO4	M											
Course Content	**UNIT - I** **Engineering Ethics:** Senses of 'Engineering Ethics' - variety of moral issues - 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** **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** **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 - oc- cupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination. **UNIT - IV** **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).	**14EC1206: BASICS OF ELECTRONICS ENGINEERING**
Text books and Reference books	**Textbooks** 1. Mike Martin and Roland Schinzinger, ”Ethics in engineering”, McGraw Hill, New York, 1996. 2. Govindarajan M, Natarajan S, Senthil Kumar V. S. , ”Engineering Ethics”, Prentice Hall of India, New Delhi, 2004. **Reference Books:** 1. Baum, R.J. and Flores, A., eds. , ”Ethical Problems in Engineer-ing, Center for the studyof the Human Dimensions ofScience and Tech-nology”, Rensellae Polytechnic Institute,Troy, New York, 335 pp, 1978. 2. Beabout, G.R., Wennemann, D.J., “Applied Professional Ethics: A Developmental Approach for Use with Case Studies”, University Press of America Lanham, MD, 175 pp, 1994.	
E-resources and other digital material		

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

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)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L											
	CO2	M											
	CO3	L											
Course Content	**UNIT - I** **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, photo-transistor, solar cell, photocouplers). **UNIT - II** **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** **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** **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).
Text books and Reference books	**Textbooks** 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. **REFERENCES:** 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

14ME1207: 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:**	30 70 100

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)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H				M							
	CO2	H											
	CO3					H							
	CO4	H											
	CO5	M				H							
	CO6					H							
Course Content	**UNIT - I** **CONCURRENT FORCES IN A PLANE**: Principles of statics, Force, Addition of two forces: Parallelogram Law - Composition and resolution of forces - Constraint, 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, Co-efficient of friction, Angle of friction, Angle of repose, Cone of friction, Wedge friction. **KINEMATICS OF RECTILINEAR TRANSLATION:** Introduction, displacement, velocity and acceleration, Motion with Uniform acceleration. **UNIT - III** **KINETICS OF RECTILINEAR TRANSLATION**: Equations of rectilinear motion, 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 & acceleration, Normal and Tangential acceleration, Motion of projectiles KINETICS OF **CURVILINEAR TRANSLATION**: D'Alembert's Principle in curvilinear motion: Rectangular components, Normal & tangential components, Work & Energy Principle.
Text books and	**Textbooks** 1. S.Timoshenko, D.H.Young, J.V.Rao & Suku-mar Pati,

Reference books	"Engineering Mechanics", Fifth Edition, Mc Graw Hill Education (India) Pvt Ltd., 2013. (For Concepts and symbolic Problems using S.I.System of Units). 2. A.K.Tayal, "Engineering Mechanics Statics and dynamics", 13th Edition, Umesh Publication, Delhi, 2006. (For numerical Problems using S.I.System of Units). **Reference Books:** 1. Beer and John-ston, "Vector Mechanics for Engineers Statics and Dynamics" 3rd SI Metric Edition, Reprint 2010, Tata McGraw Hill Publishing Company, New Delhi. 2. SS Bhavikatti and KG Rajasekharappa , "Engineering Mechanics", 4th Edition, 2012, New Age International Private Limited. **3.** K.Vijaya Kumar Reddy and J Suresh Kumar, "Singer's Engineering Mechanics Statics and Dynamics", 3rd Edition 2010, SI Units-BS Publications.
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/video.php?courseID=1048 4. http://imechanica.org/node/1551 5. http://emweb.unl.edu/

14CH1251: ENGINEERING CHEMISTRY LAB

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

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)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1				H								
	CO2					M							
	CO3		M										
Course Content	**List of Experiments** 1. Determination of total alkalinity of water sample (a) Standardization of HCl solution (b) Determination of total alkalinity. 2. Determination of chlorides in water sample (a) Standardization of $AgNO_3$ solution (b) Determination of chlorides in the water sample 3. Determination of hardness of water sample (a) Standardization of EDTA solution. (b) Determination of total hardness of water sample. 4. Determination of available chlorine in bleaching powder												

	(a) Standardization of sodium thiosulphate (b) Determination of available chlorine 5. Determination of copper in a given sample (a) Standardization of EDTA solution (b) Determination of copper 6. Determination of Mohr's salt - Dichrometry (a) Standardization of $K_2Cr_2O_7$ solution (b) Estimation of Mohr's salt 7. Determination of Mohr's salt - Permanganometry (a) Standardization of $KMnO_4$ solution (b) Estimation of Mohr's salt 8. Determination of zinc in a given sample (a) Standardization of potassium ferrocyanide solution (b) Determination of zinc 9. Conductometric determination of a strong base using a strong acid 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	**Reference Books:** 1. S.K. Bhasin and Sudha Rani, "Laboratory Manual on Engineering Chemistry", 2nd edition, Dhanpat Rai Publishing Company, New Delhi. 2. Sunita Rattan, "Experiments in Applied Chemistry", 2nd edition, S. K. Kataria & Sons, Delhi. 3. V. Alexeyev, "Quantitative Analysis", MIR Publishers, Moscow.

14CS1252: C PROGRAMMING LAB

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

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the programming terminology and implement various c-tokens and input-output statements to solve simple problems.
	CO2	Compare various looping and branching constructs and apply the best looping structure for a given problem.
	CO3	Implement arrays and structures/unions for storing homogeneous and heterogeneous groups of data.
	CO4	Implement programs using pointers to directly access memory locations and 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)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	M											
	CO2		M			M							
	CO3		M										
	CO4	L											
	CO5	L	M			M							

Course Content	**CYCLE - I: Programming constructs and control structures** 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) Data Types (b) Operands, Operators (c) Arithmetic Expressions 3. Branching and Selection: (a) Simple-if (b) Nested-if 4. Control statements: (a) Break (b) Continue (c) Go to 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: stdin, stdout and stderr (e) FILE handling functions: fgetc(), fputc(), fgets() and fputs() 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 5. Structures (a) Declaring and accessing structure members (b) Passing of structure as a function argument 6. Unions (a) Referencing Unions (b) Difference between structure and union
E-resources and other digital material	1. Numerical Methods and Programming by Prof. P.B.Sunil Kumar, De-partment 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

14ME1253: WORKSHOP PRACTICE

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

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	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. (a, b, k).
	CO2	Develop various basic prototypes in the trade of Welding such as Lap Joint, Lap Tee Joint, Edge Joint, Butt Joint and Corner Joint (a, b, k).
	CO3	Develop various basic prototypes in the trade of Tin Smithy such as Saw Edge, Wired Edge, Lap Seam, Grooved Seam and Funnel Preparations (a, b, k).
	CO4	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 (a, b, k).

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M -Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H	H									L	
	CO2	M	H									L	
	CO3	M	H									L	
	CO4	L	H									L	

Course Content

List of Experiments

1. Carpentry: To make the following jobs with hand tools
   A. Lap Joint
   B. Lap Tee Joint

	C. Dove Tail Joint D. Mortise & Tenon Joint E. Cross-Lap Joint 2. Welding using Electric Arc Welding process / Gas Welding: A. Fillet joint B. Tee joint C. Edge joint D. Butt joint E. Corner joint 3. Sheet metal operations with hand tools: i. One side inclined cylindrical pipe ii. Hexagonal pipe inclined one side iii. Square Box without lid iv. Taper Tray v. Funnel 4. House wiring: i. To connect one lamp with one switch. ii. To connect two lamps with one switch. iii. To connect a fluorescent tube. iv. Stair case wiring. v. Go down wiring.
Text books and Reference books	**Reference Books:** 1. Kannaiah P. & Narayana K. C., "Manual on Work Shop Practice", Scitech Publications, Chennai.

14MA1301: COMPLEX ANALYSIS & 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:**	30 70 100

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 (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H				M		M					
	CO2	H				M		M					
	CO3	H	M			H						M	
	CO4	H	M			H						M	
Course Content	**UNIT I:** **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:** 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 – Invertion and reflection - Bilinear transformation. **UNIT III:** **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** **Numerical Differentiation And Integration** : Finding first and second order differentials using Newton's formulae. Trapezoidal rule and Simpsons 1/3 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 Books:** 1. B.S.Grewal, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, 2012. **Reference Books:** 1. Krezig, "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons.2007, 2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishers. 3. N.P.Bali, Manish Goyal, "A Text book of Engineering Mathematics", 1st Edition, Lakshmi Publications (P) Limited, 2011 4. H.K.Das, Er. RajnishVerma, "Higher Engineering Mathematics", 1st Edition, S.Chand & Co., 2011. 5. S. S. Sastry, "Introductory Methods of Numerical Analysis", PHI, 2005.
E-resources and other digital material	1. faculty.gvsu.edu/fishbacp/complex/complex.html 2. nptelvideolectures/iitm.ac.in

14EC3302: ELECTRONIC DEVICES

Course Category:	Programme Core	**Credits:**	4
Course Type:	Theory	**Lecture -Tutorial- Practice:**	4 - 0- 0
Prerequisites:	14PH1102: Engineering Physics, 14EC1206:Basics of Electronics Engineering	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Interpret the characteristics of PN diode and its applications.											
	CO2	Bias the transistor in various configurations											
	CO3	Understand the principle of FETs and its characteristics.											
Contribution of Course outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	M	M										
	CO2	M	M										
	CO3	M	M										
Course Content	**UNIT I:** **Conduction in Semiconductors:** Conductivity of a Semiconductor, Carrier Concentrations in an Intrinsic Semiconductor, Donor and Acceptor Impurities, Charge densities in a semiconductor, Fermi level in a Semiconductor having Impurities, Diffusion, Carrier life time, Continuity equation. **Semiconductor Diode Characteristics :** Qualitative theory of P-N junction, p-n Junction as a Diode, Band Structure of an Open Circuited p-n Junction, Quantitative theory of P-N diode currents, The Volt Ampere Characteristics, The temperature dependence of P-N Characteristics, Diode Resistance, Space Charge or Transition Capacitance, Diffusion capacitances. **(18Hrs)**												

	UNIT II: **Transistor Characteristics:** The Junction Transistor**,** Transistor Current Components**,** the Transistor as an Amplifier, The Common Base Configuration, The Common Emitter Configuration, The Common Collector Configuration. **Transistor Biasing & Thermal Stabilization:** The Operating Point, Bias Stability, Collector to Base Bias, Self Bias, Stabilization against variations in V_{BE} and β for the Self Bias Circuit, Bias Compensation, Thermistor & Sensistor Compensation, Thermal Runaway and Thermal Stability. **(12Hrs)** **UNIT III:** **Filed Effect Transistors:** Construction and Characteristics of JFETs, Transfer Characteristics, Specification Sheets (JFETs), Depletion-type MOSFET and Enhancement-type MOSFET, VMOS, CMOS, MESFETs. **FET Biasing**: Introduction, Fixed Bias Configuration, Self Bias Configuration, Voltage Divider Biasing. **(12Hrs)** **UNIT – IV** **Applications of Diodes:** **Rectifiers:** Half Wave Rectifier, Ripple Factor, Full Wave Rectifier, Bridge Rectifier, Harmonic Components in rectifier circuits, Inductor filters, capacitor filters, Approximate analysis of Capacitor filters, L-section filter, Multiple L section filter, π-section filter, Voltage Regulation using Zener Diode. **PNPN Devices**: Silicon Controlled Rectifier, Basic Silicon Controlled Rectifier Operation, SCR Characteristics & Ratings, Silicon Controlled Switch, Light Activated Silicon Controlled Rectifier, Shockley Diode, DIAC, TRIAC and Uni-Junction Transistor **(12Hrs)**
Text books and Reference books	**Text Books:** 1. Jacob Millman, Christos C Halkias & Satyabrata JIT, "Millman's Electronic Devices and Circuits", 4th Edition, TMH, 2015. (Unit I, II, IV-for Applications of Diodes). 2. Robert L Boylested and Louis Nashelsky, "Electronic Devices and

	Circuit Theory", 10th Edition, Pearson India, 2009. (UNIT III & IV- for PNPN Devices). **Reference Books:** 1. David A Bell., "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008. 2. Ben G. Streetman and Sanjay Kumar Banerjee, "Solid State Electronic Devices" 6th Edition, PHI. 3. Nandita Das Gupta and Amitava Das Gupta, "Semiconductor Devices Modelling and Technology", PHI Learning Pvt. Ltd., 2013.
E-resources and other digital material	1. http://www.deas.harvard.edu/courses/es154/ 2. http://nptel.ac.in/courses/117103063/ 3. http://nptel.ac.in/courses/117106033/ 4. http://nptel.ac.in/courses/117102061/

14EC3303: NETWORK THEORY

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3 -1-0
Prerequisites:	14EE1105: Basics of Electrical Engineering	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Analyze the circuits by applying appropriate theorems											
	CO2	Get introduced to Graph theory and two-port networks											
	CO3	Design different resonant circuits for the given specification.											
	CO4	Analyze the transient response of RL, RC and RLC circuits											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2	H		L									
	CO3	H											
	CO4	H		M									
Course Content	**UNIT I:** **D.C CIRCUITS & Network Theorems:** Nodal and Loop methods of analysis. Super position theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Tellegen's theorem, Millman's theorem and Maximum Power Transform Theorem. **A.C CIRCUITS & Network Theorems** Nodal and Loop methods of analysis, Super position theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transform Theorem. **(15Hrs)** **UNIT II:** **Graph theory and Two Port Network**: Concept of Tree, Branch, Tree link, Incidence matrix, Tie-set matrix and loop currents, Cut set matrix and node pair potentials, Duality.												

	Relationship of two port variables, Short circuit admittance parameters, Open circuit impedance parameters, Transmission parameters, Hybrid parameters, Relation between parameter sets, Parallel connection of two port networks. **(15Hrs)** **UNIT III:** **Resonance and Passive Filters:** Series resonance, Parallel resonance, concept of band width and Q factor Constant-K filters- low pass, high pass, band pass and band elimination filter design, m derived filters, Composite filters. **(15Hrs)** **UNIT – IV** **Transient Analysis :** Basics - Source free Response of RL, RC and RLC Series Circuits – Forced Response of RL, RC & RLC Series circuits with Sinusoidal Excitation - Time Constant & Natural frequency of Oscillation. **(15Hrs)**
Text books and Reference books	**Text Books:** 1. M. E.Van Valkenburg "Network Analysis" 3rd edition, PHI, 2009. (Units - I & II) 2. Jr William H Hayt & Jack Kemmerly "Engineering Circuit Analysis", 6th edition, McGraw-Hill, 2000. (Units - III & IV) **Reference Books:** 1. Ravish R. Singh, "Network Analysis and Synthesis", 1st edition, McGraw-Hill. 2. Mahmood Nahvi and Joseph Edminister., "Electric Circuits", 5th edition, Schaum's Outline series, TMH, 2004. 3. A Sudhakar and SP Shyam Mohan, "Circuits and Networks: Analysis and Synthesis", 4th edition, TMH, 2002. 4. John D Ryder. "Networks, Lines and Fields", 2nd edition, PHI, 2003.
E-resources and other digital material	1. http://nptel.iitm.ac.in/courses/webcoursecontents/IIT%20kharagpur/basic%20electrical% 2. 20technology/new_index1.html 3. http://nptel.iitm.ac.in/video.php?subjectId=108102042 4. http://www.ee.washington.edu/faculty/soma/fipse/faculty_guide.pdf 5. http://www.ece.umd.edu/class/enee204.../LectureNotes/LectureMain.htm

14EC3304: DIGITAL CIRCUITS AND SYSTEMS

Course Category:	Programme Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 - 0- 0
Prerequisites:	14EC1206: Basics of Electronics Engineering	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Analyze and synthesize combinational and sequential circuits
	CO2	Design logic circuits using classical methods and use hardware description language for designing logic circuits.
	CO3	Understand the architecture of FPGAs for developing digital circuits.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H		H									
	CO2	H		H									
	CO3	L											

Course Content

UNIT I:

Combinational Logic Design Principles: Combinational-Circuit Analysis, Combinational-Circuit Synthesis:- Circuit Descriptions and Designs, Circuit Manipulations, Combinational-Circuit Minimization, Karnaugh Maps, Minimizing Sums of Products.

Hardware Description Languages: HDL-Based Digital Design, The Verilog Hardware Description Language:- Program Structure, Logic System, Nets Variables and Constants, Vectors and Operators, Arrays, Logical Operators and Expressions, Behavioral Design Elements (Procedural Code), Simulation, Verilog Features for Sequential Logic Design, Synthesis.

(15Hrs)

	UNIT II: **Combinational Logic Design Practices:** Decoders, Enoders, Three-State Devices, Multiplexers, Comparators, Adders and Subtractors - Half Adders and Full Adders, Ripple Adders, Subtractors, Carry-Look ahead Adders, MSI Adders. Combinational Logic Design Using Verilog**:** Multiplexer's, Comparator and Adders. **(15Hrs)** **UNIT III:** **Sequential Logic Design Principles:** Latches and Flip-Flops, Clocked Synchronous State-Machine Analysis, Clocked Synchronous State-Machine Design, Designing State Machines Using State Diagrams, State-Machine Synthesis Using Transition Lists **(15Hrs)** **UNIT – IV** **Sequential Logic Design Practices:** Latches and Flip-Flops, Counters, Shift Registers. Sequential Logic Design Using Verilog: Registers and Latches, counters and Shift registers. **Field-Programmable Gate Arrays:** Xilinx XC4000 FPGA Family, Configurable Logic Block, Input/Output Block, Programmable Interconnect. **(15Hrs)**
Text books and Reference books	**Text Books:** 1. John F Wakerly, "Digital Design Principles and Practices ", 4th edition, Pearson, 2013. (Unit – I to IV). **Reference Books:** 1. M.Morris Mano, Michael D. Ciletti, "Digital Logic Design", 5th edition, Prentice Hall, 2013 (Refer for Memory and Programmable Logic)Zvi Kohavi, "Switching and Finite Automata Theory", 2nd Edition, McGraw-Hill, 2004. (Refer for Minimization of Switching Functions)Thomas L. Floyd "Digital Fundamentals", 11th Edition, Pearson Education India, 2015. (Refer for Latches, Flip-Flops, and Timers)
E-resources and other digital material	1. http://www.ece.ubc.ca/~saifz/eece256.html 2. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/digital_circuit/frame/index.html

14EC3305: SIGNALS &SYSTEMS

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial - Practice:**	3-1-0
Prerequisites:	14MA1101:Linear Algebra And Differential Equations, 14MA1201:Calculus, 14MA1301: Complex Analysis & Numerical Methods	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Classify the signals and systems as continuous time and discrete time based on their properties.
	CO2	Analyze the spectral characteristics of signals using Fourier series and Fourier transforms.
	CO3	Analyze the frequency response of linear systems and apply the concepts of convolution and correlation operations on different signals.
	CO4	Apply the Transform techniques to analyze the discrete time signals & systems.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2	H											
	CO3	H	L										
	CO4	H											

Course Content	**UNIT I:** **Introduction to Signals** Continuous-Time and Discrete-Time signals, Transformation of the Independent variable, Exponential and Sinusoidal signals, unit Impulse and Unit Step functions. **Introduction to Systems** Continuous-time and Discrete-time systems, Basic system properties. Discrete time LTI Systems: The Convolution sum, Continuous Time LTI Systems: Convolution integral, Properties of Linear Time Invariant systems. **(15Hrs)** **UNIT II:** **Fourier series:** Fourier series representation of Continuous-time periodic signals, Convergence of the Fourier Series, Properties of Continuous time Fourier Series. Fourier series representation of Discrete-time periodic signals, Properties of discrete time Fourier Series. **Fourier transform:** Representation of periodic signals: The Continuous-time Fourier transform, The Fourier transform for periodic signals, Properties of the continuous time Fourier transform. Representation of Aperiodic signals: The Discrete-time Fourier transform, The Fourier transform for periodic signals, Properties of the Discrete time Fourier transform. **(15Hrs)** **UNIT III:** **Frequency Analysis of Linear Systems:** Distortion less Transmission, Ideal filters, Causality and Physical reliability, Paley-Wiener criterion, Relation between Bandwidth and Rise time. **Correlation:** Convolution and Correlation, Properties of Correlation functions, Correlation functions for Non-finite Energy Signals, Properties of Energy and Power spectral density spectrums. **(12Hrs)**

	UNIT – IV **Z–Transforms:** Introduction, Z-transform, region of convergence for the Z-transform, Inverse Z-transform: Properties of Z-transform, Analysis and characterization of LTI systems using Z-transforms **Sampling Theorem:** Introduction, The sampling theorem, Reconstruction of a signal from its samples using Interpolation, The effect of Under sampling: Aliasing. **(12Hrs)**
Text books and Reference books	**Tex Book:** 1. Alan V.Oppenheim, Alan S. Willisky, "Signals & Systems", 2nd edition, Prentice-Hall of India Private Limited, 1996. (Units: I, II &IV). 2. B P Lathi, "Signals and systems and communications", BS Publications, 2001. (Units: III) **Reference Books:** 1. Simon Haykin and Barry Van Veen , "Signals and Systems", 2nd edition John Wiley,1999. 2. M.J.Roberts., "Signals and Systems Analysis using Transform method and MATLAB", 2nd revised edition, TMH, 2003 3. Moman H Hays, " Digital Signal Processing Schaum's Outlines", 2nd revised edition, Tata Mc Graw Hill Co Ltd, 2004.
E-resources and other digital material	1. nptel.iitm.ac.in/courses.php?branch=Ece 2. www.cdeep.iitb.ac.in 3. www.dspguide.com/ch5/1.htm 4. www.stanford.edu/~boyd.ee102 5. www.ece.gatech.edu/users/bonnie/book 6. http://asyali.org/Matlab.asp

14EC3306: ELECTRICAL TECHNOLOGY

Course Category:	Programme Core	**Credits:**	2
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2 -0- 0
Prerequisites:	14EE1105: Basics of Electrical Engineering,	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand the working and performance of DC Machines.											
	CO2	Understand the working and performance of 1-Φ Transformer.											
	CO3	Understand the principle of 3- Φ Induction motors.											
	CO4	Understand the principle and regulation concepts of Synchronous Generator.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H -High)**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H	M					M					
	CO2	H	M					M					
	CO3	H						M					
	CO4	H	M					M					
Course Content	**UNIT I:** **DC Machines**: **DC Generators**: Introduction, Principle of operation of DC generator, Construction of DC Machines, EMF equation, types of generators, magnetization and load characteristics of DC shunt generator, losses and efficiency of DC generator. **DC Motors**: Principle of operation of DC motor, Back EMF, Torque equation, types of DC motors, Swinburne's test, speed control of DC motor- flux and armature control methods, Necessity												

	of DC motor starter, Three point starter. **(8 Hrs)** **UNIT II:** **Transformers:** Principle of operation of single phase transformer, emf equation of transformer, phasor diagram on no load and load, equivalent circuit, losses and efficiency of transformer, regulation of transformer, OC and SC tests. **(8 Hrs)** **UNIT III:** **Three phase Induction Motors:** Production of rotating magnetic field, Principle of operation of induction motors, slip, frequency of rotor emf and current, torque equation, simple problems. **(8 Hrs)** **UNIT – IV** **Three Phase Alternator:** Principle of Operation of Alternator, Distribution Factor, Coil Span Factor, Emf Equation, Regulation of Alternator by Synchronous Impedance Method. **(8 Hrs)**
Text books and Reference books	**Text Book:** 1. V.K.Mehta and Rohit Mehta, "Principles of electrical machines", 2nd Edition, S. Chand Publications, 2002. 2. J.B.Guptha, "A Course in Electrical Technology" Volume-II, S. K. Kataria & Sons, 2009. **Reference Books:** 1. Nagsarkar, Sukhija, "Basic Electrical Engineering", 2nd edition, Oxford Publications. 2. BL Theraja, "A text book of Electrical Technology", 24th revised edition, S Chand & Co., 2005.
E-resources and other digital material	1. www.iiitm.ac.in 2. www.nptel.com 3. MIT video lessons

14EC3351 ELECTRONIC DEVICES & DIGITAL ELECTRONICS LAB

Course Category:	Programme Core	**Credits:**	2
Course Type:	Practical	**Lecture-Tutorial-Practice:**	0- 0- 3
Prerequisites:	14EE1105: Basics of Electrical Engineering, 14EC3304: Digital Circuits and Systems	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Design rectifier circuits for given specifications											
	CO2	Design an amplifier using various biasing circuits											
	CO3	Design combinational logic circuits using gates, basic building blocks and HDL											
	CO4	Design sequential circuits using flip flops, registers, counter ICs and HDL											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M -Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	POh	PO i	PO j	POk	PO l
	CO1				L					M			
	CO2				L					M			
	CO3				L					M			
	CO4				L					M			

Course Content

List of Lab Exercises:

Experiments Based on Electronic Devices

1. Characteristics of PN junction diode and Zener diode
2. Analysis of Bridge rectifier with and without L, C filters.
3. Characteristics of Transistor in Common Base and Common Emitter Configuration.
4. Self-Bias circuit for transistor.
5. Characteristics of Junction Field Effect Transistor
6. Characteristics of Uni Junction Transistor
7. Characteristics of SCR.

	Experiments Based on Digital Electronics 1. Realization of Logic Gates using discrete components and ICs. 2. Design of combinational logic circuits (Half Adder, Full Adder, Half Subtractor, Full Subtractor) using fundamental and Universal Logic gates 3. Design of Multiplexer, Demultiplexer, Encoder and Decoder circuits 4. Design of Shift Registers, Ring counter and Johnson counter 5. Design of Synchronous and Asynchronous counters. 6. Simulate Combinational Logic Design Using Verilog HDL-Multiplexer's. 7. Simulate Sequential Logic Design Using Verilog HDL -counters.

NB: A minimum of 10(Ten) experiments (5 from each section) have to be performed and recorded by the candidate to attain eligibility for External Practical Examination

14EC3352: ELECTRICAL TECHNOLOGY LAB

Course Category:	Programme Core	**Credits:**	2
Course Type:	Practical	**Lecture-Tutorial-Practice:**	0- 0- 3
Prerequisites:	14EE1105: Basics of Electrical Engineering,	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Validate AC and DC theorems											
	CO2	Perform and examine various tests on machines											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M -Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	M	H					M					
	CO2	M	H					M					
Course Content	**List of Experiments**: 1. Verification of KVL and KCL 2. Verification of Superposition Theorem 3. Verification of Reciprocity and Maximum Power Transfer Theorem 4. Verification of The venin's Theorem 5. Parameters of Choke Coil 6. Resonance of RLC Series and Parallel Circuits 7. OCC of DC Shunt Generator 8. Load Test on DC Shunt Generator 9. Load Test on DC Compound Generator												

	10. Speed Control of DC Shunt Motor 11. Swinburne's Test on DC Shunt Machine 12 a. OC and SC Test on Single Phase Transformer b. Direct Load Test on Single Phase Transformer 13. Regulation of Three Phase Alternator by Synchronous Impedance M 14. Direct Load Test on Three Phase Induction Motor

NB: A minimum of 10(Ten) experiments (5(five) from Circuits and 5(five) from Machines) have to be performed and recorded by the candidate to attain eligibility for External Practical Examination.

14HS 1353: COMMUNICATION SKILLS LAB

Course	Programme Core	**Credits:**	2

Category:			
Course Type:	Lab	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:	14HS1104:Technical English &Communication skills -	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

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 (H- Highly Mapped, M-Moderately Mapped, L- Low)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1									M	H	M	L
	CO2						H	M	M	H	H	M	M
	CO3	M	H	M	L	L	H	H	H	H	H	M	H
	CO4	M	M	M	M	H	H	H	H	H	H	H	H
	CO5		L		L	L	H	H	H	M	H	H	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 Books:** 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, II edition, (Pocket Books) Simon & 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, I 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.

14EC3401: PROBABILITY THEORY AND RANDOM PROCESSES

Course Category:	Programme Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4 -1-0
Prerequisites:	14MA1201:Calculus, 14MA1101:Linear Algebra and Differential Equations, 14MA1301:Complex Analysis ad Numerical Methods, 14EC3305:Signals and systems	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Develop the probability distribution and density functions of random variables and compute the statistical parameters.											
	CO2	Characterize LTI systems driven by a stationary random process using autocorrelation and power spectral density functions.											
	CO3	Analyze and compute the noise performance of communication system											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M -Medium, H – High)**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2	H	L										
	CO3	H	L										
Course Content	**UNIT-I** **Probability:** Probability introduced through Sets and Relative Frequency, Joint Probability and Conditional Probability, Independent Events, Combined Experiments, Bernoulli trials**.** **(6Hours)**												

	Random Variables: The Random Variable Concept, Distribution Function and Density function, Q Function, Error Function, The Gaussian Random Variable, Other Distribution and Density Examples. Conditional Distribution and Density Functions. **(6Hours)** **Operations on One Random Variable:** Expectation, Moments, Functions that give Moments, Transformations of a Random Variable. **(5Hours)** **UNIT-II** **Multiple Random Variables** : Vector Random Variables, Joint Distribution and its Properties, Joint Density and its Properties, Conditional Distribution and Density, Statistical Independence, Distribution and Density of Sum of Random Variables, Central Limit Theorem, (Proof not expected) **(7Hours)** **Operations on Multiple Random Variables**: Expected Value of a Function of Random Variables, Joint Characteristic Functions, Jointly Gaussian Random Variables, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables. **(7Hours)** **UNIT-III** **Random Process**: Random Process Concept, Stationary and Independence, Correlation Functions, Measurement of Correlation Functions, Gaussian Random Process, Poisson Random Process**.** **(6Hours)** **Random Process Spectral Characteristics**: Linear system with random inputs**,** Power Density Spectrum and its properties, Relationship between Power Spectrum and Auto Correlation Function, Cross Power Density Spectrum and its properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function. Random signal response of linear systems, SpectralCharacteristicsofSystemResponse. **(7Hours)** **UNIT – IV** **Noise:** Shot Noise, Thermal Noise, Noise Calculations: Single Noise Source, Multiple Sources: Superposition of Power Spectra, Noise Calculations in Passive Circuits, Equivalent. Noise Bandwidth, Noise Figure of an Amplifier, Power Density and Available Power Density, Effective Noise Temperature, Noise Figure in Terms of Available

	Gain, Cascaded Stages. **(12Hours)**
Text books and Reference books	**Text Book:** 1. Peyton Z. Peebles, "Probability, Random Variables & Random Signal Principles", 4th Edition, TMH, 2002. (Units - I, II, III) 2. B.P. Lathi, "Signals, Systems & Communications", B.S. Publications, 4th Edition, 2009. (Unit - IV). **Reference Books:** 1. Athanasios Papoulis,S.Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", 4rd Edition, TMHl, 2002. (UNITS –I,II,III) 2. R.P. Singh and S.D. Sapre, "Communication Systems: Analog & Digital", 3rd Edition, TMH, 2012. (Units –I,II,IV) 3. Mallikarjuna Reddy.Y, "Probability Theory and Stochastic Processes", 4th Edition, University Press, 2013. (UNITS I, II, III, IV).
E-resources and other digital material	1. http://nptel.iitm.ac.in/video.php?subjectId=117105085 2. http://walrandpc.eecs.berkeley.edu/126notes.pdf 3. http://statweb.stanford.edu/~adembo/stat-310a/lnotes.pdf

14EC3402: ELECTRONIC CIRCUITS

Course Category:	Programme Core	**Credits:**	4
Course Type:	Theory	**Lecture-Tutorial-Practice:**	4-0-0
Prerequisites:	14EC3302:Electronic Devices	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Design and analyze single stage amplifiers using BJT and FET at Low and High Frequencies.
	CO2	Design and analyze multistage amplifiers using BJT.
	CO3	Design and analyze Feedback amplifiers and Oscillators using BJT.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M-Medium, H-High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L	H										
	CO2	L	H										
	CO3	L	H										

Course Content

UNIT I

Transistor at Low Frequencies: Two Port Devices and Hybrid Model, Transistor Hybrid Model, The h Parameters, Analysis of Transistor Amplifier Circuit Using h Parameters, Emitter Follower, Millers Theorem and its Dual, Cascading Transistor Amplifiers. Simplified Common Emitter Hybrid Model, Simplified Calculations for the Common Collector Configuration, Common Emitter Amplifier With an Emitter Resistance and High Input Resistance Transistor Circuits.

FET Amplifiers: JFET Small Signal Model, Fixed Bias Configuration, Self Bias Configuration, Voltage Divider Configuration, Common Gate Configuration, Common Drain configurations. **(12 Hrs)**

UNIT II

Transistor at High Frequencies: The Hybrid pi (π) Common Emitter Transistor Model, Hybrid Π Conductances, The Hybrid Π Capacitances, Validity of Hybrid π Model, Variation of Hybrid π Parameters. The CE Short-Circuits Current Gain, Current Gain with Resistive Load, Single Stage CE Transistor Amplifier Response, The Gain-Bandwidth Product, Emitter Follower at High Frequencies.

FET at High Frequencies: The Common Source FET Amplifier at High Frequencies and the Common Drain FET Amplifier at High Frequencies. **(12 Hrs)**

UNIT III

Multistage Amplifiers: Classification of Amplifiers, Distortion in Amplifiers, Frequency Response of an Amplifier, Step Response of

	an Amplifier, Band Pass of Cascaded Stages, The RC Coupled Amplifier, Effect of Emitter Bypass Capacitor on Low Frequency Response, High Frequency Response of Two Cascaded CE Transistor Stages, Multistage CE Amplifier Cascade at High Frequencies, Cascode Amplifier. **(12 Hrs)** **UNIT IV** **Feedback Amplifiers:** Classification of Amplifiers, The Feedback Concept, The Transfer Gain with Feedback, General Characteristics of Negative Feedback Amplifiers, Input Resistance Output Resistance, Method of Analysis of a Feedback Amplifier, Voltage Series Feedback, Current Series Feedback, Current Shunt Feedback, Voltage Shunt Feedback. **Oscillators:** Sinusoidal Oscillators, The Phase Shift Oscillator Using BJT, A General Form of Oscillator Circuit, The Wein Bridge Oscillator, Crystal Oscillators, Frequency Stability, Hartley & Colpitt's Oscillators Using BJT. **(14 Hrs)**
Text books and Reference books	**Text Books:** 1. Jacob Millman, Christos C. Halkias and Chetan D Parekh, "Integrated Electronics", 2nd Edition, Tata McGraw Hill Publication, 2012. (Units I,II,III & IV) . 2. Robert L Boylested and Louis Nashelsky, "Electronic Devices and Circuit Theory", 10th Edition, Pearson India, 2009. (UNIT IV). **Reference Books:** 1. Donald L. Schilling and Charles Belove, "Electronic Circuits - Discrete and Integrated", 3rd Edition, TMH, 2002. 2. Donald A Neamen, "Electronic Circuits: Analysis And Design", 3rd Edition, TMH, 2008.
E-resources and other digital material	1. http://nptel.ac.in/courses/117107095/ 2. http://ocw.metu.edu.tr/course/view.php?id=105

14EC3403: ELECTROMAGNETIC FIELD THEORY

Course Category:	Programme Core	**Credits:**	4
Course Type:	Theory	**Lecture -Tutorial - Practice:**	4 -1- 0
Prerequisites:	14MA1201:Calculus, 14MA1301: Complex Analysis and Numerical Methods	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Apply appropriate physical law of electrostatics depending on the type of charge distribution to solve the engineering problems involving static electric fields.
	CO2	Apply appropriate physical law of magneto statics depending on the type of current distribution to solve the engineering problems involving static magnetic fields.

<table>
<tr><td></td><td>CO3</td><td colspan="12">Analyze the time varying electromagnetic fields by applying appropriate Maxwell’s equation and boundary conditions.</td></tr>
<tr><td></td><td>CO4</td><td colspan="12">Analyze time harmonic electromagnetic field problems by applying appropriate boundary conditions at an interface of different types of media for plane waves incident with different angles.</td></tr>
<tr><td rowspan="5">Contribution of Course Outcomes towards achievement of Program Outcomes

(L – Low, M - Medium, H – High)</td><td></td><td>PO a</td><td>PO b</td><td>PO c</td><td>PO d</td><td>PO e</td><td>PO f</td><td>PO g</td><td>PO h</td><td>PO i</td><td>PO j</td><td>PO k</td><td>PO l</td></tr>
<tr><td>CO1</td><td>H</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td>H</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td>M</td><td></td><td>L</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td>M</td><td></td><td>L</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Course Content</td><td colspan="13">UNIT – I
Electrostatics: Introduction, Coulomb’s Law and Field Intensity, Electric Fields due to Continuous Charge Distributions, Electric Flux Density, Gauss’s Law, Applications of Gauss Law, Electric Potential, Relationship Between E and V, Maxwell’s Equations for static fields, Potential and Field of Electric Dipole, Energy Density in Electrostatic Fields, Convection and Conduction Currents, Polarization in Dielectrics, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson’s and Laplace’s Equations, Capacitance, Boundary conditions - Dielectric-Dielectric, Conductor-Dielectric, Conductor- Free space. (25 Hrs)
UNIT – II
Magnetostatics:Introduction, Biot - Savart’s Law, Ampere’s circuit law, Applications of Ampere’s law, Magnetic flux density, Maxwell’s equations for static fields, Magnetic Vector and Scalar potentials, Force due to magnetic field, Magneticdipole, Magnetic Energy, Magnetic Boundary conditions. (10Hrs)
UNIT – III
Maxwell’s Equations: Magnetic Induction and Faraday’s Law, The Equation of Continuity for Time Varying Fields, Inconsistency of Ampere’s Law, Maxwell’s Equations, Conditions at a Boundary Surface, The Wave Equations for a Conducting Medium, Solution for Free-Space Conditions, Uniform Plane-Wave Propagation, Uniform plane waves. (15 Hrs)
UNIT – IV</td></tr>
</table>

	EM Waves: Sinusoidal Time Variations, Conductors and Dielectrics, Polarization, Reflection by a Perfect Conductor-Normal Incidence, Reflection by a Perfect Conductor-Oblique Incidence, Reflection by a Perfect Dielectric -Normal Incidence, Reflection by a Perfect Insulator - Oblique Incidence, Brewster angle, Total internal reflection, Surface impedance, Skin depth, Poynting's Theorem. **(15 Hrs)**
Text books and Reference books	**Text Books:** 1. Mathew N O Sadiku, "Principles of Electromagnetics", 4th edition, Oxford External Press, 2003. (Units - I, II) 2. E C Jordan and K G Balmain, "Electromagnetic Waves and Radiating Systems", PHI, 2003. (Units - III, IV) **Reference books:** 1. Joseph A Edminister, "Theory and Problems of Electromagnetics", 2nd edition, Schaum's Outline Series, McGraw Hill, 1993 2. W H Hayt , "Engineering Electromagnetics", TMH, 1997 3. J. D. Kraus, "Electromagnetics", 5th edition, McGraw Hill l, 1999. 4. Nathan Ida, "Engineering Electromagnetics", 2nd edition Springer (India) Pvt. Ltd., New Delhi, 2005.
E-resources and other digital material	1. http://nptel.iitm.ac.in/video.php?subjectId=10810607 2. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm 3. http://www.mike-willis.com/Tutorial/PF2.htm

14HS1404: ENVIRONMENTAL STUDIES

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

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the various natural resources, analyze and explore degradation management
	CO2	Understand the Ecosystems and need of Biodiversity
	CO3	Explore the Problems related to Environmental pollution and management
	CO4	Apply the Role of Information Technology and analyze social issues, Acts associated with Environment.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M -Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L											L
	CO2						H		H				
	CO3					L	H		H				
	CO4								H	H			L

Course Content

UNIT -I

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

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:

(a) Forest ecosystem

(b) Grassland ecosystem

(c) Desert ecosystem

(d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and Its Conservation

Introduction, definition: genetic, species and ecosystem diversity.

Biogeographically 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

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.

Diaster management: Floods, earthquake, cyclone and landslides.

UNIT IV

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.

Wasteland 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 Programme. 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:** 1. **"**ENVIRONMENTAL STUDIES" for under graduate courses of all branches of higher education – Erach Bharucha -- For University Grants Commission. **Reference Book:** 1. AnjaneyuluY, "Introduction to Environmental sciences", B S Publications PVT Ltd, Hyderabad.
E-resources and other digital material	1. collegesat.du.ac.in/UG/Envinromental%20Studies_ebook.pdf

14EC3405: COMPUTER ARCHITECTURE AND ORGANIZATION

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3– 0- 0
Prerequisites:	14CS1103:Introduction to Computing, 14EC3304: Digital Circuits and Systems	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Demonstrate computer functional units, its operation and also interpret machine coding of functional units.											
	CO2	Evaluate the performance of CPU, Memory and I/O operations.											
	CO3	Appreciate the pipelined architecture of processors.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M -Medium, H – High)**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2	L											
	CO3	M											
Course Content	**UNIT-I** **BASIC STRUCTURE OF COMPUTERS** Computer types, Functional units, Basic operational concepts, Bus structures, Performance, Multiprocessors and Multicomputers. **MACHINE INSTRUCTIONS** Numbers, Arithmetic Operations and Characters, Memory locations and addresses, Memory operations, Instructions and Instruction sequencing, Addressing modes, Assembly language, Basic Input/Output Operations, Stacks and Queues, Subroutines. **(10Hrs)** **UNIT-II** **ARITHMETIC** Addition and subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-Operand Multiplication, Fast Multiplication, Integer Division, Floating-Point												

	Numbers and Operations. **BASIC PROCESSING UNIT** Fundamental concepts, Execution of a complete instruction, Multiple-Bus organization, Hardwired Control, Micro programmed control **(10Hrs)** **UNIT-III** **MEMORY SYSTEM** Basic concepts, Semiconductor RAM, ROM, Speed Size and cost, Cache memories, Performance considerations, Virtual Memories, Memory Management requirements, Secondary storage. **(8Hrs)** **UNIT-IV** **I/O ORGANIZATION** Accessing Input/ Output devices, Interrupts, Direct memory access, Buses, Interface Circuits **PIPELINING** Basic concepts, Data hazards, Instruction hazards, Influence on instruction sets, Data path and control considerations, Superscalar Operations, Performance considerations. **(12Hrs)**
Text books and Reference books	**Text Books:** 1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", 5th Edition, Tata McGraw Hill, 2002. (Unit – I to IV). **References:** 1. William Stallings, "Computer Organization and Architecture Designing for Performance", 9th Edition, Pearson Education, 2013.(Refer for Internal Memory Technology) 2. Patterson, D. A., and Hennessy, J.L., "Computer Organization and Design: The Hardware/Software Interface", 4rd Edition, Morgan Kaufmann, 2009. (Refer for Interfacing I/O Devices to the Processor, Memory and Operating Systems) 3. Hayes, J.P., "Computer Architecture and Organization", 3rd Edition, Tata McGraw Hill, 1998.(Refer for Design of Arithmetic Logic for Computers)
E-resources and other digital material	**E Resources:** 1. http://nptel.iitk.ac.in/courses/Webcourse-contents/IIT-KANPUR/CompArchitecture/page2.htm 2. http://nptel.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/comp_org_arc/web/ 3. http://williamstallings.com/ComputerOrganization/styled-7/

14EC3406: ANALOG COMMUNICATIONS

Course Category:	Programme Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	4– 0- 0
Prerequisites:	14EC3305:Signals and Systems	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand the generation and detection of continuous signals using different modulation techniques.											
	CO2	Comprehend the working principles of radio transmitters and receivers											
	CO3	Analyze the noise performance of AM & FM receivers											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M -Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2	H	L										
	CO3	L											
Course Content	**UNIT-I** **Amplitude Modulation:** Time domain description, Frequency Domain Description, Generation of AM waves, Detection of AM waves. Double Side Band-Single Carrier Modulation: Time and Frequency Domain Description, Generation of DSBSC waves, Coherent detection of DSBSC Modulated Waves, Costas Loop. **SSB &VSB Modulations:** Single Side Band Modulation: Frequency Domain Description, Generation of SSB-SC Wave, Frequency-Discrimination Method, Phase Discrimination method, Demodulation of SSB-SC Waves, Vestigial Side-Band Modulation, Frequency Domain Description, Generation of VSB Modulated Wave, Envelope Detection of VSB Wave Plus Carrier. **(15Hrs)** **UNIT-II** **Angle Modulation:** Frequency Modulation: Single Tone Frequency												

	Modulation, Spectrum Analysis, Narrow Band FM, Wideband FM, Transmission Bandwidth of FM, Generation of FM Waves, Demodulation of FM Waves, Phase Locked Loop (PLL) Limiting IF FM Waves, Applications of FM Waves. **Pulse Modulation:** Basic principles of PAM, PWM, PPM-Generation and Detection techniques. **(12 Hrs)** **UNIT-III** **Radio Transmitters:** Classification of Radio Transmitters, AM Radio Transmitters, Carrier frequency requirements of Radio Transmitter, Master Oscillator, Methods of frequency modulation, Armstrong FM Transmitter. **Radio Receivers:** Receiver Types, AM Receivers**,** FM Receivers-Comparison with AM Receivers, Amplitude limiting, Basic FM demodulators, Radio detector **(15 Hrs)** **UNIT-IV** **Noise in Analog Modulation:** AM Receiver model, Signal to Noise Ratios for Coherent Reception. Noise in AM receivers using Envelope Detection. FM receiver model, Noise in FM reception, Threshold Effect, Pre-emphasis and De-emphasis in FM. **(12 Hrs)**
Text books and Reference books	**Text Books:** 1. Simon Haykin. "Introduction to Analog and Digital Communication Systems", 2nd edition, John Wiley and Sons, 2009. (Units - I, II &III) 2. George Kennedy & Bernard Davis, "Electronic Communication systems", 4th edition, TMH India, 2009. **References:** 1. G. K. Mithal, "Radio Engineering", 20th edition, Khanna Publishers, 2011. (Unit - IV) 2. Taub and Schilling, "Principles of Communication Systems", 2nd edition, TMH, 2004. 3. A Bruce Carlson, PB Crilly, JC Rutledge, "Communication Systems", 4th Edition, McGraw Hill, New York, 2002.
E-resources and other digital material	**E Resources:** 1. http://nptel.iitm.ac.in/viedo.php?subjectId=117102059 2. http://web.engr.oregonstate.edu/~magana/ECE461-561/index.htm

14EC3451: ELECTRONIC CIRCUITS LAB

Course Category:	Programme Core	**Credits:**	2
Course Type:	Practical	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	14EC3402: Electronic Circuits	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Design a BJT amplifier at low frequencies for given specifications.											
	CO2	Design and analyze a multistage amplifier.											
	CO3	Design and analyze feedback amplifiers and oscillators.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M -Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1				M	M				M			
	CO2				M	M				M			
	CO3				M	M				M			
Course Content	**List of Lab Exercises:** **Experiments based on Simulation:** 1. Design of Voltage Shunt Feedback Amplifier 2. Frequency Response of CE Amplifier with and without Feedback 3. Design of Current Shunt Feedback Amplifier 4. Design of RC Phase Shift and Wein bridge Oscillator 5. Design of Radio Frequency Oscillators (Hartley and Colpitt's												

	Oscillators) 6. Frequency Response of Two Stage RC – Coupled Amplifier **Experiments based on Electronic circuits** 7. Design of Voltage Series Feedback Amplifier 8. Design of Current Series Feedback Amplifier 9. Frequency Response of CE Amplifier with and without Feedback 10. Design of Darlington emitter follower circuit 11. Design of RC Phase shift and Wein Bridge Oscillator 12. Design of Hartley and Colpitt's Oscillator

NB: A minimum of 10(Ten) experiments (5 from each section) have to be performed and recorded by the candidate to attain eligibility for External Practical Examination

14EC 3452: ANALOG COMMUNICATIONS LAB

Course Category:	Programme Core	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0– 0- 3
Prerequisites:	14EC3406: Analog Communications	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Experimentally the working of AM, FM and PM techniques and the various parameters involved in it.											
	CO2	Experimentally the working of PAM, PWM and PPM techniques and the various parameters involved in it.											
	CO3	Experimentally the working of Mixer, Squelch & AGC Circuits.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1				H	M				M			
	CO2				H					M			
	CO3				M					M			
Course Content	**List of Lab Exercises:** **Experiments using Hardware (using Discrete Components):** **1.** Amplitude Modulation and Demodulation **2.** Frequency Modulation and Demodulation **3.** DSB SC Modulation and Demodulation **4.** SSB SC Modulation and Demodulation **5.** Pre Emphasis - De Emphasis Circuits **6.** PAM and Reconstruction **7.** PWM Generation and Reconstruction **8.** Design of Mixer **9.** AGC characteristics												

	Experiments using Software(using Lab VIEW): **10.** Amplitude Modulation and Demodulation **11.** Frequency Modulation and Demodulation **12.** DSB SC Modulation and Demodulation **Experiments using Specialized Equipment (using Spectrum Analyzer):** **13.** Amplitude Modulation and Demodulation **14.** Frequency Modulation and Demodulation **Extra Experiments(Special Circuits):** **15.** Squelch Circuit **16.** Frequency Synthesizer
E-resources and other digital material	1. http://iitg.vlab.co.in/?sub=59&brch=163 **2.** http://www.scribd.com/doc/27104963/ANLOG-COMMUNICATION Lecture-06

Note: A minimum of 10(Ten) experiments have to be performed and recorded by the candidate to attain eligibility for External Practical Examination.

14EC3501: LINEAR CONTROL SYSTEMS

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3-1-0
Prerequisites:	14ME1207:Mechanics for Engineers 14EC3305: Signals &Systems	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand the concepts of feedback control systems and model the physical systems											
	CO2	Determine and analyze the linear systems using time domain analysis.											
	CO3	Determine and analyze the linear systems using frequency response plots.											
	CO4	Design and evaluate the compensators for linear systems to meet the desired specifications using bode-plots and understands the state space approaches.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M -Medium, H – High)**		POa	POb	POc	POd	POe	POf	POg	POh	POi	POj	POk	PO l
	CO1	M											
	CO2	H											
	CO3	H											
	CO4	M											
Course Content	**UNIT I:** **Introduction:** Basic Components of a Control System, Examples of Control System Applications, Open Loop Control Systems, Closed Loop Control Systems, Effect of Feedback on Overall Gain, Effect of Feedback on Stability, Effect of Feedback on Sensitivity, Effect of Feedback on External Disturbance or Noise, Types of Feedback Control												

	Systems - Linear Versus Nonlinear Control Systems, Time Invariant Versus Time Varying Systems. **Mathematical Modeling of Physical Systems:** Introduction, Equations of Electric Networks, Modeling of Mechanical System Elements, Impulse Response and Transfer Functions of Linear Systems, Block Diagrams, Signal Flow Graphs, Summary of the Basic Properties of SFG, Definition of SFG Terms, SFG Algebra, Gain Formula for SFG, Application of the Gain Formula to Block Diagrams. **UNIT II:** **Time Domain Analysis of Control Systems:** Time Response of Continuous Data Systems, Typical Test Signals for the Time Response of Control Systems, Steady State Error, Unit Step Response and Time Domain Specifications, Transient Response of Prototype Second Order System, Effect of Adding Poles and Zeros to Transfer Functions, Dominant Poles of Transfer Function. **Stability of Linear Control Systems:** Introduction, Bounded Input – Bounded Output Stability, Zero Input and Asymptotic Stability of Continuous Data Systems, Methods of Determining Stability Routh-Hurwitz Criterion. **UNIT III:** **Root-Locus Technique:** Introduction, Basic properties of the Root Loci, Properties and Construction of the Root Loci, Root Contours, Some important aspects of the construction of the Root Loci. **Frequency-Domain Analysis:** Introduction, M_r, W_r, Bandwidth of the Prototype Second-Order System, Effect of adding Poles and Zeros to the Forward-Path Transfer Function, Nyquist Stability Criterion, Nyquist Criterion for Systems with Minimum-Phase Transfer Functions, Relative Stability, Stability Analysis with the Bode Plot, Stability Analysis with the Magnitude-Phase Plot, Constant - M Loci in the G(jw) - Plane, Constant-Phase Loci in the G(jw)-Plane, Nichols Chart. **UNIT – IV:** **Design of Control Systems**: Introduction, Design with the Phase-Lead Controller, Design with the Phase-Lag Controller, Design with the Lead-Lag Controller. **State Variable Analysis**: Introduction, State Transition Matrix, State

	Transition Equation, Relation Between State Equations and Transfer Functions, Characteristic Equation, Eigen Values and Eigen Vectors, Controllability of Linear Systems, Observabiliy of Linear Systems, Relationship among Controllability, Observabiliy and Transfer Functions.
Text books and Reference books	**Text Books:** 1. Benjamin C. Kuo, "Automatic Control Systems", 7th edition, PHI, 2013. **Reference Books:** 1. J Nagrath & M Gopal, "Control Systems Engineering", 3rd edition, New Age International, 2003. 2. K Ogata, Modern Control Engineering, 4th edition, Pearson Education, 2003.
E-resources and other digital material	1. http://nptel.iitm.ac.in/video.php?subjectId=108101037 2. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT Delhi/Control%20system%20design%20n%20principles/index.htm 3. http://en.wikibooks.org/wiki/Control_Systems 4. http://www.ebookpdf.net/linear-control-systems-ppt_ebook

14EC3502: PULSE AND SWITCHING CIRCUITS

Course Category:	Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial -Practice:**	4-0-0
Prerequisites:	14EC3302: Electronic Devices, 14EC3402: Electronic circuits.	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Analyze, design and verify the conversion efficiency of Power Amplifiers and frequency response of Tuned amplifiers.											
	CO2	Analyze, design and verify the response of Linear & Non-Linear Wave shaping circuits to different inputs.											
	CO3	Analyze, design and verify the states of Multivibrator Circuits.											
	CO4	Analyze, design and verify the outputs of time based generators and blocking oscillators.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M-Medium, H – High)		POa	POb	POc	POd	POe	POf	POg	POh	POi	POj	POk	PO l
	CO1		M	M									
	CO2		M	M									
	CO3		M	M									
	CO4		M	M									
Course Content	**UNIT I:** **Power Amplifiers:** Class A Large Signal Amplifiers, Second Harmonic Distortion, Higher Order Harmonic Generation, Transformer Coupled Audio Power Amplifier, Efficiency, Push-Pull Amplifiers, Class B Amplifiers, Class AB Operation, **Tuned Amplifiers:** Band pass Amplifiers, The Parallel Resonance Circuit, and Impedance Variations at Frequencies near Resonance,												

Transformation from the Series Resistance Form, Single Tuned Amplifier, Inductively Coupled Circuits, Tuned Primary Amplifier, Tuned Secondary FET Amplifier, Double Tuned Transformer Coupled Amplifier, Stagger Tuned Amplifier.

UNIT II:

Linear Wave Shaping: The High pass RC Circuit, The High pass RC Circuit: Exponential &

Ramp Inputs, The High pass RC Circuit as a Differentiator, Low pass RC Circuit, The Low pass RC Circuit (Exponential & Ramp Inputs), the Low Pass RC Circuit as a Integrator, Attenuators

Non-Linear Wave Shaping: Clipping Circuits, Diode Clippers, Clipping at Two Independent Levels, The Clamping Operation, Clamping Circuits Taking Source and Diode Resistances into Account, A Clamping Circuit Theorem and Practical Clamping Circuits.

UNIT III:

Multivibrators:

Bistable Multivibrator: The Stable States of a Bistable Multivibrator, A Fixed Bias Transistor Bistable Multivibrator, Self Bias Transistor Bistable Multivibrator, Commutating Capacitors, Methods of Improving Resolution, Unsymmetrical Triggering of the Bistable Multivibrator. Triggering Unsymmerically through a Unilateral Device, Symmetrical Triggering, and Schmitt Trigger.

Monostable and Astable Multivibrators: The Monostable Multivibrators, Gate Width of a Collector Coupled Monostable Multivibrator, Waveforms of The Collector Coupled Monostable Multivibrators, The Astable Collector Coupled Multivibrator.

UNIT – IV

Time Base Generators:

Voltage Time Base Generators: General Features of a Time Base Signal, Methods of Generating a Time Base Waveform, Exponential Sweep Circuit, A Transistor Constant Current Sweep, Miller and Boot Strap Time Base Generators-General Considerations, The Transistor Miller Time Base Generator, The Transistor Boot Strap Time Base Generator.

	Current Time Base Generators: A Simple Current Sweep, Linearity Correction through Adjustment of Driving Waveform, A Transistor Current Time Base Generator. **Blocking Oscillators**: A Triggered Transistor Blocking Oscillator (Base Timing), A Triggered Transistor Blocking Oscillator (Emitter Timing).
Text books and Reference books	**Text Books:** 1. John D Ryder, "Electronic Fundamentals and Applications: Integrated and Discrete Systems" 5th Edition, PHI, 2003. 2. Jacob Millman and Herbert Taub, "Pulse, Digital and Switching Waveforms, 3rd Edition, TMH, 2003. (UNIT II, III & IV). **Reference Books:** 1. Jacob Millman and Christos C Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems", TMH, 2003. (UNIT-I for Power amplifiers) 2. Robert L Boylested and Louis Nashelsky, "Electronic Devices and Circuit Theory", 8th Edition, 2002, PHI. 3. Deshpande, "Electronic Devices and Circuits", Tata McGraw-Hill. 4. A. Anand Kumar, "Pulse and Digital Circuits", 2nd Edition, PHI, 2008.
E-resources and other digital material	1. http://nptel.iitm.ac.in/courses.php?branch=Ece. 2. http://web.cecs.pdx.edu/~ece2xx/ECE221/Lectures/. 3. http://newton.ex.ac.uk/teaching/CDHW/Electronics2/ElectronicsResources.html.

14EC3503: MICROPROCESSOR AND MICROCONTROLLER

Course Category:	Programme Core	**Credits:**	4
Course Type:	Theory	**Lecture-Tutorial-Practice:**	4-1-0
Prerequisites:	14EC3304:Digital circuits and systems, 14EC3405:Computer architecture and organization.	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Apprehend the internal architecture of 8086microprocessor.											
	CO2	Develop assembly language program for small applications using 8086.											
	CO3	Apprehend the internal architecture of 8051microcontroller.											
	CO4	Develop assembly language program for small applications using 8051.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M -Medium, H – High)**		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H											
	CO2		M	M									
	CO3	H											
	CO4		M	M									
Course Content	**UNIT I:** **The processors: 8086 architecture, pin diagram and timing diagram:** Register organisation of 8086, architecture, signal description of 8086,physical memory organisation, general bus operation, I/O addressing capability, minimum mode 8086 system and timings, maximum mode 8086 system and timings. **8086 instruction set and assembler directives:** Machine language instruction formats, addressing modes of 8086, instruction set of 8086, assembler directives and operators.												

	UNIT II: **Interrupts and interrupt service routines:** interrupt cycle of 8086, non- maskable interrupt, maskable interrupt, interrupt programming. **Basic peripherals and their interfacing with 8086:** interfacing I/O ports, PIO 8255, modes of operation of 8255, interfacing analog to digital data converters, interfacing digital to analog converters, stepper motor interfacing. **UNIT III:** **8051 Microcontroller:** Introduction to Microcontroller and Embedded Processor; Overview on 8051 Family; Architecture and Memory Organization, Assembly Language Programming, Arithmetic and Logic Instructions, JUMP, LOOP and CALL Instructions, Addressing Modes. **UNIT – IV:** Programs on Arithmetic and Logic Instructions, Programming in C, I/O Port Programming. Timers Programming in Assembly and C, Serial Port Programming in Assembly and C, Interrupts programming.
Text books and Reference books	**Text Books:** 1. A K Ray, K M Bhurchandi, "Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing", 2nd Edition, 2004, TMH. (Units-I & II). 2. Mohammed Ali Mazidi and Janice Gillispie Mazidi, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education Asia, New Delhi, 2008. (Unit-III &IV). **Reference Books:** 1. Douglas V Hall, "Microprocessors and Interfacing: Programming and Hardware", 2nd edition, TMH, 2003. *(For 8086 practical system examples)* 2. Kenneth J Ayala, "The 8051 Microcontroller", 3rd edition, 2004, Cengage Learning . *(For examples of 8051 assembly code)*
E-resources and other digital material	1. http://nptel.iitm.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/New_index1.html - (For 8085 & advanced microprocessors) 2. http://www.datasheetarchive.com/intel%208086%20microprocessor-datasheet.html - (8086 datasheet) 3. http://www.datasheetarchive.com/8051-datasheet.html - (8051 datasheet)

14EC3504: DIGITAL COMMUNICATIONS

Course Category:	Programme Core	**Credits:**	4
Course Type:	Theory	**Lecture-Tutorial-Practice:**	4-0-0
Prerequisites:	14EC3401:Probability Theory And Random Processes 14EC3406:Analog Communications	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Identify the constituents of a digital communications system
	CO2	Analyze & demonstrate various methods of baseband and band pass digital transmission and Detection methods.
	CO3	Understand the basics of information theory and characterize the influence of channel.
	CO4	Describe and determine the performance of different error control coding schemes for the reliable transmission of digital information over the channel.

Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High)**		POa	PO b	POc	POd	POe	POf	POg	POh	POi	PO j	POk	PO l
	CO1	H											
	CO2	H											
	CO3	H											
	CO4	H											

Course Content	**UNIT I:** **Pulse Modulation**: Sampling Process, Quantization Process, Pulse Code Modulation, Delta Modulation, Differential Pulse Code Modulation, Adaptive Differential Pulse Code Modulation. **Baseband Pulse Transmission**: Matched filter, Properties, Error Rate Due to Noise, Intersymbol Interference, Nyquist's criterion for

	Distortion less Baseband Binary Transmission, Correlative Level Coding. **UNIT II:** **Passband Digital Transmission**: Introduction, Passband Transmission Model, Geometric Interpretation of Signals, Coherent Detection of Signals in Noise, Probability of Error, Correlation Receiver, Detection of Signals with Unknown Phase: Coherent Phase Shift Keying, Coherent Frequency Shift Keying, Non Coherent Binary Frequency Shift Keying, Differential Phase Shift Keying. **UNIT III:** **Information Theory:** Introduction, Uncertainty, Information and Entropy, Source Coding Theorem, Data Compaction, Discrete Memory Less Channels, Mutual Information, Channel Capacity, Channel Coding Theorem, Differential Entropy and Mutual Information for Continuous Ensembles, Information Capacity Theorem. **UNIT – IV:** **Error Control Coding:** Linear Block Codes, Cyclic Codes, Convolution Codes, Maximum Likelihood Decoding of Convolution Codes.
Text books and Reference books	**Text Books:** 1. Simon Haykin, "Communication Systems", John Wiley & Sons, 4th edition, 2007.(Units - I, II, III & IV) **Reference Books:** 1. Bernard Sklar, "Digital Communication", 2nd edition, Pearson Education, 2013. 2. Taub and Schilling, "Principles of Communication Systems", 2nd edition, TMH, 1986
E-resources and other digital material	1. http://nptel.iitm.ac.in/video.php?subjectId=117101051 2. http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Khragpur/Digi%20Comm/ New_index1.html 3. http://nptel.iitm.ac.in/courses/117108044/ 4. http://www.ece.utah.edu/~npatwari/ece5520/lectureAll.pdf

14EC3507: TRANSMISSION LINES AND WAVEGUIDES

Course Category:	Core	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3+1
Prerequisites:	14EC3403: Electromagnetic Field Theory	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Demonstrate and compute various parameters for loaded transmission lines using either a Smith chart or classical theory.											
	CO2	Design matching networks for loaded transmission lines											
	CO3	Gain knowledge about propagation of waves in guided waves											
	CO4	Analyze the characteristics of rectangular and circular waveguides											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		POa	POb	POc	POd	POe	POf	POg	POh	POi	PO j	POk	PO l
	CO1	M											
	CO2	M		L									
	CO3	M		L									
	CO4	M		L									
Course Content	**UNIT I** **Transmission Lines:** A Line of Cascaded T-Sections, Transmission Line - General Solution, Physical Significance of the Equations; Infinite Line, Wavelength, Velocity of Propagation, Waveform Distortion, The Distortion Less Line, Telephone Cable, Inductance Loading of Telephone Cables, Reflection on a Line not Terminated in Z_o, Reflection Coefficient, Input and Transfer Impedance, Open and Short Circuited Lines, Reflection Factor and Reflection Loss,												

	Insertion Loss, T and II Section equivalents to Lines. **UNIT II** **Transmission Line at Radio Frequencies:** Parameters of Open Wire Line at High Frequencies, Parameters of Coaxial Lines at High Frequencies, Constants for the Line of Zero Dissipation, Voltages and Current on Dissipation Line, Standing Waves, Standing Wave Ratio, Input Impedance of the Dissipation Less Line, Input and Output Impedance of Open and Short Circuited Lines, Power and Impedance Measurement on Lines, Reflection Losses on the Unmatched Line, Single Stub Matching on a Line, Double Stub Impedance Matching , Smith Charts. **UNIT III** **Guided Waves :** Waves between Parallel Planes, Transverse Electric Waves, Transverse Magnetic Waves, Characteristics of TE and TM Waves, Transverse Electromagnetic Waves, Velocities of Propagation, Attenuation in Parallel Plane Guides. **UNIT-IV** **Rectangular Waveguides:** Transverse Magnetic Waves, Transverse Electric Waves, Impossibility of TEM Waves in Hollow Waveguides, Wave Impedance and Characteristic Impedance, Attenuation Factor and Q - Factor of Wave Guide. **Circular Waveguides:** TE and TM Waves in Circular Waveguides, Wave Impedance and Characteristic Impedance, Dielectric slab waveguides
Text books and Reference books	**Text books** 1. John D Ryder, "Networks Lines and Fields", 1995, PHI. (Units - I & II) 2. E C Jordan and K G Balmain, "Electromagnetic Waves and Radiating Systems", 2nd edition, 2003, PHI. (Units - III & IV) **Reference Books:** 1. M N O Sadiku, "Elements of Electromagnetic", 3rd edition, 2003, Oxford University Press. 2. T Anil Kumar, "Networks and Transmission Lines" 2004, Pearson Education.
E-resources and other digital material	1. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm 2. http://nptel.iitm.ac.in/video.php?subjectId=117101056 3. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Transmission%20Lines%20and%20EM%20WaveTOC.htm 4. http://www.mike-willis.com/Tutorial/PF2.htm 5. http://www.learn-about-electronics.com/waveguide-transmission.html

14EC3551: PULSE & SWITCHING CIRCUITS LAB

Course Category:	Programme Core	**Credits:**	2
Course Type:	Practical	**Lecture-Tutorial-Practice:**	0– 0- 3
Prerequisites:	14EC3302: Electronic Devices, 14EC3402: Electronic circuits	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course Outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Hands on experience on various digital modulation techniques											
	CO2	Hands on experience on various coding techniques											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M-Medium, H – High)		POa	POb	POc	POd	POe	POf	POg	POh	POi	POj	POk	PO l
	CO1	M	H									M	
	CO2	M	H									M	
Course Content	**List of Experiments** 1. Design and verification of Linear Wave Shaping circuits (RC Low pass & High pass) with different time constants 2. Design and verification of Non-Linear Wave Shaping circuits (Clippers & Clampers) 3. Design of Monostable Multivibrator 4. Design of Astable Multivibrator 5. Design of Schmitt Trigger Circuit 6. Design of UJT Relaxation Oscillator 7. Design of Boot Strap Voltage Sweep Circuit 8. Design of Transistor Miller Sweep Circuit 9. Design of Transistor Class-A Power Amplifier												

	10. Design of Class-B Complimentary Symmetry Push-Pull Power Amplifier 11. Design of Single Tuned Amplifier 12. Design of Current Sweep Circuit **NB:** A minimum of 10(Ten) experiments, have to be performed and recorded by the candidate to attain eligibility for Practical Examination.
E-resources and other digital material	1. shaikanwar.weebly.com/uploads/3/9/2/2/3922423/pdc**lab**manual.pdf

14EC3552: DIGITAL COMMUNICATION LAB

Course Category:	Programme Core	**Credits:**	2
Course Type:	Practical	**Lecture -Tutorial-Practice:**	0-0-3
Prerequisites:	14EC3504: Digital Communication 14EC3406: Analog Communication	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course Outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Hands on experience on various digital modulation techniques											
	CO2	Hands on experience on various coding techniques											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M -Medium, H – High)		POa	POb	POc	POd	POe	POf	POg	POh	POi	POj	POk	POl
	CO1	M	H									M	
	CO2	M	H									M	
Course Content	**List of Lab Exercises:** **<u>Experiments using Hardware:</u>** 1. Generation and Detection of ASK, FSK and PSK. 2. Generation and Detection of PCM. 3. Generation and Detection of TDM 4. Generation and Detection of DM 5. Generation and Detection of QPSK 6. Generation and Detection of DPCM 7. Generation and Detection of ADM 8. Companding 9. Source Encoder and Decoder												

	10. Design and verification of Linear Block Code-Encoder and Decoder 11. Design and verification of Cyclic Code - Encoder and Decoder 12. Design and verification of Convolution Code - Encoder and Decoder **<u>Experiments using Specialized Equipment (using Spectrum Analyzer):</u>** 13. Analysis of FDM 14. Eye –diagram analysis **NB:** A minimum of 10(Ten) experiments (5 from each section) have to be performed and recorded by the candidate to attain eligibility for External Practical Examination
E-resources and other digital material	1. http://vlab.co.in/ba_labs_all.php?id=1 2. web.stanford.edu/class/ee104/lecture24.ps 3. ocw.mit.edu/courses/electrical.../6...communication.../lecture_2.pdf

14EC3601: LINEAR INTEGRATED CIRCUITS AND APPLICATIONS

Course Category:	Programme Core	**Credits:**	4
Course Type:	Theory	**Lecture-Tutorial-Practice:**	4-0-4
Prerequisites:	14EC3303:Network Theory 14EC3302: Electronic Devices And Circuits	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand the basic concepts of Differential Amplifier circuits											
	CO2	Able to design filter circuits for specific applications.											
	CO3	Understand the basics of analog to digital converters (ADC), and digital to analog converters (DAC) and Gain knowledge in designing a stable voltage regulators											
	CO4	Understand the applications of PLL and special ICs.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M -Medium, H – High)**		POa	POb	POc	POd	POe	POf	POg	PO h	POi	PO j	POk	POl
	CO1	L	M										
	CO2	L	H	M									
	CO3	L	H	M									
	CO4	L	M										
Course Content	**UNIT - I** **Operational Amplifier:** Introduction, Basic Information of Op-amp, The ideal Operational Amplifier, Operational Amplifier Internal Circuit, FET Operational Amplifier. **Operational amplifier characteristics**: DC characteristics, AC characteristics. **Operational amplifier Applications:** Basic Op-amp Applications, Instrumentation Amplifier, Op-amp Circuits using Diodes, Sample and Hold Circuits, Log and Antilog amplifier, Differentiator,												

	Integrator. **UNIT – II** **Comparators and Waveform Generators:** Introduction, Comparator, Regenerative Comparator (Schmitt Trigger), Square Wave Generator (Astable Multivibrator), Monostable Multivibrator, Triangular Wave Generator, Basic Principles of Sine Wave Oscillators. **Active Filters:** Introduction, RC active filters, Transformations, State Variable Filter **UNIT – III** **D-A and A-D Converters:** Introduction, Basic DAC Techniques A-D Converters, DAC/ADC specifications **Voltage Regulators**: Introduction, Series Op-amp Regulator, Design and Analysis of Series and Shunt Regulators using Discrete Components, Protection Techniques, IC Voltage Regulators, 723 General Purpose Regulators **UNIT – IV** **Applications of Special ICs:** **555 Timer:** Introduction, Description of Functional Diagram, Monostable operation, Astable Operation, Schmitt Trigger. **Phase Locked Loops**: Introduction, Basic Principles, Phase Detector/Comparator, Voltage Controlled Oscillator (566), Low Pass Filter, Monolithic PLL (565), PLL Applications.
Text Books and References Books	**Text Books:** 1. D. Roy Choudhary, Shail Jain, "Linear Integrated Circuits", 4th edition, New Age International Pvt. Ltd., 2010. **Reference Books** 1. Ramakant A. Gayakwad, "OP-AMPs and Linear Integrated Circuits", 4th edition, Prentice Hall, 2000. 2. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", 3rd edition. McGraw-Hill, 2002.
E-resources and other digital material	1. Freevideolectures.com › Electrical Engineering › UC Berkeley 2. nptel.ac.in/courses/122104013/main1.html

14EC3602: COMPUTER NETWORKS

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

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand the services and interfaces of the Open system interconnection (OSI) model.											
	CO2	Implement error detection and correction by using cyclic redundancy check code for any frame to be transmitted.											
	CO3	Write different Routing algorithms useful for Network layer.											
	CO4	Understand the basics of Domain name system, Electronic mail & World wide web.											
Contribution of Course Outcomes towards achievement of Program Outcomes **(L – Low, M - Medium, H – High)**		POa	POb	POc	POd	POe	POf	POg	POh	POi	PO j	POk	POl
	CO1	M	L										
	CO2	M		L									
	CO3	M	L										
	CO4	M											
Course Content	**UNIT – I** **Introduction:** Uses of Computer Networks, Network Hardware, The OSI Reference Model, The TCP/IP Reference Model, Example Networks. **The Physical Layer** : Guided Transmission Media, Wireless Transmission. **UNIT – II** **The Data Link Layer** : Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols,												

	Sliding Window Protocols, Example Data Link Protocols. **Medium Access Control Sub Layer** : The Channel Allocation Problem, Multiple Access Protocols, Ethernet, Wireless LANS, Data Link Layer Switching. **UNIT – III** **The Network Layer**: Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Internet working, The Network Layer in the Internet. **UNIT – IV The Transport Layer**: The Transport Service, Elements of Transport Protocols, The Internet Transport Protocols: UDP, The Internet Transport Protocols: TCP. **Application Layer**: Domain Name System, Electronic Mail, The World WEB
Text books and Reference books	**Text books** 1. Andrew S Tanenbaum, ”Computer Networks”, 4th edition, Pearson Education. **Reference Books:** 1. Behrouz A. Forouzan “Data Communications and Networking”. 4th edition, TMH. 2. S. Keshav, “An Engineering Approach to Computer Networks”, 2nd edition, Pearson Education. 3. W. A.Shay “Understanding Communications and Networks”, 3rd edition, Thomson.
E-resources and other digital material	1. http://home.iitk.ac.in/~navi/sidbinetworkcourse/lecture1.ppt 2. http://nptel.iitm.ac.in/courses/IITMADRAS/Computer_Networks/index.php 3. http://www.ebookpdf.net/computer-networks-lecture-notes tanenbaum_ebook_.html

14EC3603: ANTENNAS AND WAVE PROPAGATION

Course Category:	Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3
Prerequisites:	14EC3403: EMF Theory, 14EC3507: Transmission Lines and Waveguides	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Analyze the Current distributions & power radiation of different radiating elements											
	CO2	Understand the antenna fundamentals and obtain radiation pattern of various types of antenna arrays											
	CO3	Design resonant, non resonant, Micro strip, VHF,HF,UHF antennas											
	CO4	Understand the characteristics of different wave propagation mechanisms											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		POa	POb	POc	POd	POe	POf	POg	POh	POi	POj	POk	PO l
	CO1	H		M									
	CO2	M											
	CO3	M	M										
	CO4	M											
Course Content	**UNIT I** **Radiation And Antenna Fundamentals**: Introduction, Basic Antenna parameters, Radiation patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna apertures, Effective Height and Area, Radio communication link, Fields form oscillating dipole, Antenna Fields zones, polarization, Retarded Potentials, Fields due to alternating current element, Power radiated by current element, Far and near field due to sinusoidal current distribution												

	UNIT II **Wire Antennas And Antenna Arrays:** Fields of a short dipole, Radiation resistance of short electric dipole, Thin linear antenna, Radiation resistance of λ/2 antenna, Fields of thin linear antenna with uniform travelling wave, Loop antenna general case, Radiation resistance of loop antenna. **Antenna Arrays:** Array of two isotropic point sources, non isotropic point sources and principle of multiplication of patterns, Linear array of n point sources (Broad side array, End-fire array) , Linear array with non-uniform amplitude distribution, array of two driven λ/2 elements broad side case, array of two driven λ/2 elements end fire case. Horizontal and vertical antennas above a plane ground. Binomial Array **UNIT III** **VHF and UHF Antennas**: V and Rhombic Antennas, Folded Dipole, Dipole array with parasitic elements, Yagi Uda array, Horn antennas ,Helical antenna, Practical design considerations, Principle of operation, Reflector antennas, parabolic reflector, corner reflector, Feed methods for parabolic reflectors, Microstrip Antenna: Advantages ,limitations and feed methods of rectangular microstrip antenna. **UNIT – IV** **Radio Wave Propagation:** Ground Wave Propagation, Space-Wave Propagation: Field Strength Relation, Effect of Earth, Super Refraction, Tropospheric Propagation. Sky Wave Propagation: Structural details of the Ionosphere, Wave propagation Mechanism, Refraction and Reflection of Sky waves by Ionosphere, Ray Path, Critical frequency, MUF,LUF,OF, virtual Height and Skip distance, Relation between MUF and the Skip Distance, Multi-Hop propagation.
Text books and Reference books	**Text books:** 1. Edward C Jordan and Keith G Balmin. "Electromagnetic Waves and Radiating Systems", 2nd edition, 2003, PHI,.(Units - I & IV) 2. Constantine A Balanis, "Antenna Theory: Analysis and Design", Harper and Row Publishers, 2002. (Units - II, III)

	Reference Books: 1. J. D. Kraus and Ronald J Marhefka Ahmad S khan "Antennas and Wave Propagation", Tata McGraw Hill, 4th edition, 2010.
E-resources and other digital material	1. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm 2. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Transmission%20Lines%20and%20EM%20Waves/TOC.htm 3. http://courses.cit.cornell.edu/ece303/Lectures/Lectures.htm 4. http://www.ccs.neu.edu/home/rraj/Courses/G250/F07/Notes/Antennas.pdf

14EC3604: VLSI DESIGN

Course Category:	Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial -Practice:**	4-0-0
Prerequisites:	14EC3302:Electronic Devices, 14EC3402: Electronic Circuits	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Analyze VLSI fabrication processes and CMOS Logic Design.
	CO2	Identify the physical circuit parameters and analyze the effects of parasitic on overall performance of the circuit.
	CO3	Design the different memory modules at transistor level for given specifications

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		POa	PO b	POc	POd	POe	POf	POg	POh	POi	POj	POk	POl
	CO1	M		M									
	CO2					M							
	CO3	M		M									
	CO4		M	M	M	M		M				M	

Course Content	**UNIT – I** **Introduction to MOS Technology**: The Integrated circuit era, MOS VLSI technology, Basic MOS transistors, Enhancement mode transistor action, Depletion mode transistor action, NMOS fabrication, CMOS fabrication, BICMOS technology **Basic Electrical Properties Of MOS and BICMOS Circuits**: Drain-to-Source Current I_{ds} versus Voltage V_{ds} relationships, Aspects of MOS Transistor Threshold voltage V_t, MOS Transistor Trans conductance gm and Output Conductance g_{ds}, MOS Transistor Figure of Merit, Pass Transistor, NMOS inverter, Pull-Up to Pull- Down Ratio for and NMOS Inverter

	driven by another NMOS Inverter, Pull-up to pull- down ratio for and NMOS Inverter Driven by one or more Pass Transistors, Alternative forms of Pull-up, CMOS Inverter, Latch-up in CMOS Circuits. **UNIT – II** **MOS Circuit Design Processes:** MOS Layers, Stick Diagrams, Design Rules and Layout Basic Circuit Concepts: Sheet Resistance Rs, Standard Unit of Capacitance, The Delay Unit, Inverter Delays, Driving Large Capacitive Loads, Propagation Delays, Wiring Capacitances, Choice of Layers **UNIT – III** **Scaling of MOS Circuits**: Scaling Models and Scaling Factors, Scaling Factors for Device Parameters. Subsystem Design and Layout: Architectural Issues, Switch Logic, Gate Logic, Examples of Structured Design (Combinational Logic) **UNIT – IV** **Sub System Design Processes**: An Illustration of Design Process, Design of an ALU Subsystem, A Further Consideration of Adders, Multipliers **Memory, Registers and Aspects of System Timing**: System Timing Considerations, Commonly Used Storage/ Memory Elements. **Test and Testability:** Testing Combinational and Sequential Logic
Text books and Reference books	**Text books:** 1. Douglas A. Pucknell and Kamran Eshranghian, "Basic VLSI Design", 3rd edition, 2005, PHI **Reference Books:** 1. Wayne Wolf, "Modern VLSI Design: System-on-Chip Design", 3rd edition, 2004, Prentice Hall. 2. Neil H E Weste and Kamran Eshranghian., "Principles of CMOS VLSI Design - A system perspective", 2nd edition, 2002, Pearson Education.
E-resources and other digital material	1. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/VLSI%20Design/Course %20Objective.htm 2. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/VLSI%20Design/TOC.ht m 3. http://nptel.iitm.ac.in/video.php?subjectId=117106092

14EC3605: DIGITAL SIGNAL PROCESSING

Course Category:	Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial -Practice:**	4-1-0
Prerequisites:	14MA1101:Linear Algebra & Differential Equations 14EC3305:Signals & Systems	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Apply DIT and DIF FFT algorithms for efficient computation of the DFT											
	CO2	Design and verify the frequency response of Digital IIR Filters.											
	CO3	Design and verify the frequency response of Digital FIR filters											
	CO4	Describe the effects of finite word length registers and cause of limit cycles in the implementation of IIR and FIR digital filters.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		POa	POb	POc	POd	POe	POf	POg	POh	POi	POj	POk	POl
	CO1	H											
	CO2	H				H							
	CO3	H				H							
	CO4	M											
Course Content	**UNIT I:** **The Discrete Fourier Transform - Its Properties and applications:** Frequency Domain Sampling : The Discrete Fourier Transform – The Discrete Fourier Transform (DFT), Properties of the DFT, Linear Filtering methods based on the DFT.												

	Efficient Computation of the DFT- Fast Fourier Transform Algorithms: Efficient Computation of the DFT: FFT Algorithms - Direct Computation of the DFT, Divide-and-Conquer approach to Computation of the FFT, Radix-2 FFT Algorithms. Applications of FFT Algorithms – Use of the FFT Algorithm in Linear Filtering and Correlation. **UNIT II:** **Design of IIR Filters from analog Filters:** IIR filter Design by Approximation of Derivatives, IIR Filter Design by Impulse Invariance, IIR filter Design by the Bilinear Transformation, Characteristics of commonly used Analog Filters. Frequency Transformations - Frequency Transformations in the Analog Domain, **Structures for IIR Systems**: Direct-Form Structures, Cascade-Form Structures, Parallel-Form Structures. **UNIT III:** **Design of FIR Filters**: General Conditions, Design of FIR Filters - Symmetric & Anti-symmetric FIR filters, Design of Linear-phase FIR filters using Windows, Design of Linear Phase FIR filters by the Frequency-Sampling Method, Comparison of Design methods for Linear-Phase FIR filters. **Structures for FIR Systems:** Direct Form Structures, Cascade Form Structures. **UNIT – IV** **Finite Word Length Effects in Digital Filters:** Representation of Numbers, Quantization of Filter Coefficients, Round-Off effects in Digital Filters. **Introduction to Multirate Digital signal Processing**: Introduction, Decimation by a Factor *D*, Interpolation by a Factor *I*, Sampling rate conversion by a Rational Factor *I/D*.
Text books and Reference books	**Text Books:** **1.** John G. Proakis, & Dimitris G. Manolakis, **"**Digital Signal Processing : Principles, Algorithms and Applications", 4th Edition, 2007, Prentice-Hall of India Private Limited, (Units - I, II, III & IV)

	Reference Books: **1.** Ifeacher E.C. & Jervis B.W, "Digital Signal Processing, A Practical Approach", 3rd edition, *2003,* Addison Wesley. **2.** Lonnie C Ludeman, "Fundamentals of Digital Signal Processing", John Wiley & Sons, 2003. **3.** S K Mitra, "Digital Signal Processing: A Computer Based Approach", 2nd edition, 2003, TMH.
E-resources and other digital material	1. http://nptel.iitm.ac.in/video.php?subjectId=108105055 2. http://nptel.iitm.ac.in/video.php?subjectId=117102060 3. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/Digi_Sign_Pro/ui/TOC.htm 4. http://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/study-materials/ 5. http://www.ece.cmu.edu/~ee791/ 6. http://cobweb.ecn.purdue.edu/~ipollak/ee438/FALL04/notes/notes.html

14EC3651: LINEAR INTEGRATED CIRCUITS & APPLICATIONS LAB

Course Category:	Program Core	**Credits:**	2
Course Type:	Practical	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	14EC3304: Digital Circuits & Systems 14EC3604: VLSI Design	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the concepts of linear integrated circuits and special IC's (IC 565, IC 566) and use them for different applications
	CO2	Design oscillators, waveform generators and filter circuits using IC741
	CO3	Use the concepts of A/D , D/A converters and design voltage regulators
	CO4	Design the circuits using 555 timers for particular application

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

	POa	POb	POc	PO d	POe	POf	POg	POh	POi	PO j	PO k	PO l
CO1			H	H								
CO2			H	H								
CO3												
CO4												

Course Content

List of Experiments

1. Measurement of Op-Amp Parameters
2. Design of a differential amplifier
3. Design and Verification of Applications of Op-amp (Adder, Subtractor, Integrator, Differentiator)
4. Design of Full wave rectifier using 741 IC
5. Design of Instrumentation Amplifier using Op-Amp
6. Design of Triangular waveform generators using 741 IC
7. Design of Monostable and Schmitt Trigger circuit using 741 IC
8. Design of Active Filters using Op-Amp (Second Order LPF &

	HPF circuits) 9. Design of Voltage Regulator using IC 723 10. Design of 4-bit R – 2R Ladder D-A Converter 11. Verification of Applications of IC 555 Timer (PPM, PWM and FSK) 12. Design a PLL using 556 **NB: A minimum of 10(Ten) experiments have to be performed and recorded by the candidate to attain eligibility for External Practical Examination.**
Text books and Reference books	1. D.Roy Choudhary, Shail Jain, "Linear Integrated Circuits", 4th edition, New Age International Pvt. Ltd., 2010. 2. Ramakant A.Gayakwad, 'OP-AMP and Linear IC's', Prentice Hall / Pearson Education, 1994. 3. Sergio Franco, 'Design with operational amplifiers and analog integrated circuits', McGraw-Hill, 1997.
E-resources and other digital material	1. http://www2.mvcc.edu/~jfiore/et262.html

14EC3652: VLSI DESIGN LAB

Course Category:	Program Core	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial -Practice:**	0-0-3
Prerequisites:	14EC3304 Digital Circuits & Systems 14EC3604 VLSI Design	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Model a digital system using Hardware Description Language and implement using FPGA and CPLD devices.											
	CO2	Characterize CMOS digital circuits and verify DC and transient analysis											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		POa	POb	POc	POd	POe	POf	POg	POh	POi	POj	PO k	PO l
	CO1			H	H								
	CO2			M	M								
Course Content	**Simulate and Synthesis the following modules using Verilog HDL and verify the design on FPGA/CPLD** <u>Basic Combinational Circuits</u> 1. 8 to 3 Priority Encoder 2. BCD to 7 Segment Display 3. 4 bit Magnitude Comparator <u>Basic Sequential Circuits</u> 4. JK flip-flop with a test bench 5. Modulo-N Up Down Counter 6. Digital Clock 7. Universal Shift register												

	Design of Sub Systems 8. 16-Bit ALU with 8 Arithmetic Operations, 4 Logic Operations and 2 Shift Operations 9. FIFO – First In First Out 10. Sequence Detector using FSM **Verify the characteristics of the following digital CMOS circuits by performing DC and Transient Analysis** 11. Inverter. 12. NAND. **NB: A minimum of 10(Ten) experiments have to be performed and recorded by the candidate to attain eligibility for External Practical Examination.**

14EC3701:Electronic Measurements and Instrumentation

Course Category:	**Core**	**Credits:**	3
Course Type:	**Theory**	**Lecture - Tutorial -Practice:**	3
Prerequisites:	**Circuit theory**	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Emphasize the basic electronic measurement concept and measure the voltage, current and power using different.

	CO2	Measurement of different bridges.											
	CO3	Select and use different analyzers and oscillators to make measurements and analyze measurements											
	CO4	Analyze the basic concepts of Data Acquisition and conversion.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	L		L									
	CO2	M		L									
	CO3	M		L									
	CO4	L		L									
Course Content	**UNIT I: Basic Electronic Measurement Concepts:** Introduction Performance characteristics-Static & Dynamic Measurement, Error Analysis, Statistical Analysis, Limiting error, DC Ammeter, Multi-range Ammeter, Aryton shunt, Basic meter as a DC-Voltmeter, DC Voltmeter, Multi-range voltmeter, Extending voltmeter, Instruments for Measuring Basic Parameters- AC Voltmeters Using Rectifiers, Multi-range AC voltmeters, True RMS voltmeter, Peak responding voltmeters, Average responding voltmeters. **UNIT II: Bridges and DVM Measurements:** Introduction to Bridge Measurements – Wheatstone, Kelvin, Guarded Wheatstone, Maxwell, Hay, Schering, Wien Bridge, Wager Ground Connection, Resonance bridge, Digital Voltmeter - Ramp, Stair Case Ramp, Integrating, Continuous Balance, Successive Approximation Resolution and Sensitivity of Digital Meters. **UNIT III: Oscilloscopes and Signal Generators:** Introduction, Basic principle Block diagram of CRO, Applications of Oscilloscopes, Digital storage oscilloscope. Signal generator -Fixed and variable, AF-Oscillator, Function Generator, Square and pulse generator, Sweep generator, Beat frequency oscillator, Harmonic Distortion Analyzers, Spectrum Analyzer. **UNIT IV : Data Acquisition and Conversion:** Introduction, Objectives of Data Acquisition system, Signal conditioning of the inputs, signal channel data acquisition system,												

	Multi channel DAS, Computer based DAS, Digital to Analog and Analog to Digital converters, Electro Mechanical A/D Converters.
Text books and Reference books	Text Book: 1. H S Kalsi, "Electronics Instrumentation, TMH, 1995.(Units I,II,III,IV) **Reference Books:** 1. Albert D. Helfrick and William D .Cooper "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2003. 2. A K Sawahney, "Electrical And Electronics Measurement and Instrumentation", Dhanpat Rai,2000. 3. Ernest O. Doebelin, "Measurement Systems- Application and Design" Tata McGrawHill-2004.

14EC3702: CELLULAR AND MOBILE COMMUNICATIONS

Course Category:	**Program core**	**Credits:**	3C
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	Design a cellular system using frequency reuse concept.
	CO2	Understand basic propagation mechanisms.
	CO3	Understand the GSM architecture with different channels
	CO4	Be aware of next generation cellular technologies

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	POd	PO e	PO f	PO g	PO h	PO i	PO j	POk	PO l
	CO1	M											
	CO2	M											
	CO3	M											
	CO4	M											

Course Content	**UNIT I: Introduction to Wireless Communication Systems:** Evolution of Mobile Radio Communications, Examples of Wireless Communication Systems, Comparison of Common Wireless Communication Systems. **Cellular Concept:** Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems.

	UNIT II: Mobile Radio Propagation: Large Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link-Budget Design Using Path Loss Models. **Small-Scale Fading and Multipath:** Small-Scale Multipath Propagation, Types of Small-Scale Fading, Statistical Models for Multipath Fading Channels. Fundamentals of Equalization, Linear Equalizers, Nonlinear Equalization, Diversity Techniques, RAKE Receiver. **UNIT III: Wireless Networking:** **Common Channel Signaling**: Signaling System No.7, Signalling traffic in SS7, SS7 services, performance of SS7, Example of SS7-Global cellular network inter operatability. **Global System For Mobile (GSM):** GSM Services and Features, GSM System Architecture, GSM Radio Subsystem, GSM Channel Types, GSM Traffic Channels, GSM Control Channels, Examples of GSM Call, Frame Structure for GSM, Signal Processing in GSM. **UNIT IV: Next Generation Cellular Technology 4G** Introduction, 4G evolution, Advantages of 4G over 3G, Applications of 4G, Limitations of 4G, New Technologies in Cellular Data Networks
Text books and Reference books	**Text Books:** 1. Theodore Rappaport, "Wireless Communications – Principles and Practices", 2nd edition, 2008, Prentice Hall of India, New Delhi. **(Units - I, II & III)** **2.** G Sasibhusan Rao, " Mobile Cellular Communications, Pearson Publications, 2013 **(Unit – IV)** **Reference books:** 1. W. C. Y. Lee, "Mobile Cellular Communications", 2nd edition, 1995, McGraw Hill. 2. Kamilo Feher, "Wireless Digital Communications", 2003, PHI.
E-resources and other digital material	1. http://nptel.iitm.ac.in/syllabus/117103016/ 2. http://nptel.iitm.ac.in/video.php?courseId=1036 3. http://rechargesvec.blogspot.in/2011/09/cellular-and-mobile-communications-cmc.html

14EC3703: DSP PROCESSORS AND ARCHITECTURES

Course Category:		**Credits:**	4
Course Type:		**Lecture - Tutorial -Practice:**	4-1-0
Prerequisites:	Signals and systems, Digital Signal Processing	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand architecture of DSP Processor- TMS320C5X											
	CO2	Implement basic DSP algorithms using DSP Processors											
	CO3	Develop high performance Advanced Digital Signal Processors.											
	CO4	Design high-end application processors.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		POa	POb	POc	POd	POe	POf	POg	POh	POi	PO j	POk	POl
	CO1	H	M										
	CO2		M	M									
	CO3		M	M									
	CO4		M	M									
Course Content	**UNIT I: Computational Accuracy in DSP Implementations:** Number Formats for Signals and Coefficients in DSP Systems, Dynamic Range and Precision, Sources of Error in DSP Implementations, A/D Conversion Errors, DSP Computational Errors, D/A Conversion Errors. **Architectures for Programmable DSP Devices:** Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing. **UNIT II: Execution Control And Pipelining:** Hardware Looping, Interrupts, Stacks, Relative Branch Support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching Effects, Interrupt Effects, Pipeline Programming Models. **Programmable Digital Signal Processors:** Commercial Digital												

	Signal-Processing Devices, Data Addressing Modes of TMS320C54XX DSPs, Data Addressing Modes of TMS320C54XX Processors, Memory Space of TMS320C54XX Processors, Program Control, TMS320C54XX Instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54XX Processors. **UNIT III : Implementations Of Basic DSP Algorithms:** The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing. **Implementation Of FFT Algorithms:** An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and Scaling, Bit-Reversed Index Generation, An 8-Point FFT Implementation on the TMS320C54XX, Computation of the Signal Spectrum. **UNIT – IV: Interfacing Memory and I/O Peripherals g.ho Programmable DSP Devices:** Memory Space Organization, External Bus Interfacing Signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts And I/O, Direct Memory Access (DMA). A Multichannel Buffered Serial Port (MCBSP), MCBSP Programming, A CODEC Interface Circuit, CODEC Programming, A CODEC-DSP Interface Example.
Text books and Reference books	**Text Books:** 1. Avatar Singh and S.Srinivasan, "DSP Processors and Architectures", 2004, Thomson Publications. (Units-I,III & IV) 2. Lapsley et al, "DSP Processor Fundamentals, Architectures & Features" 2000, S. Chand & Co (Unit-II) **Reference Books:** 1. B. Venkataramani and M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications" , 2002, TMH. **2.** Jonatham Stein, "Digital Signal Processing", 2005, John Wiley.
E-resources and other digital material	1. www.ti.com/lit/ug/spru131g/spru131g.pdf 2. http://en.wikipedia.org/wiki/Digital_signal_processor 3. http://www.scribd.com/doc/8968585/Architecture-of-DSP-Processors

14HS1604 ENGINEERING ECONOMICS AND FINANCE

Lectures: 3 Periods / Week
Continuous Evaluation: 30

Semester end Exam: 3 hrs
Semester end Evaluation: 70

Credits: 3

Course Outcomes:

CO1: Understand various forms of organisations and principles of management**.(a,**l)

CO2: Understand the various aspects of business economics.(a,e,l)

CO3: Acquire knowledge on Human resources and Marketing functions.(a,l)

CO4: understand best alternatives for various investment decisions and different depreciation methods .(a,e,l)

Contribution of Course Outcomes towards achievement of Program Outcomes

(L-Low, M-Medium, H-High)

CO	Programme Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
CO 1	**M**											**M**
CO 2	**M**				**H**							**M**
CO 3	**M**											**M**
CO 4	M				**H**							**M**

UNIT I

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

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

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

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

Learning Resources:

Text Books:

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 Edition 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

Web Resources:

www.tectime.com
www.exinfm.com
www.slideshare.net
www.economywatch.com

14EC4705/1: OPTICAL COMMUNICATION

Course Category:	**Program Elective**	**Credits:**	3
Course Type:	**Theory**	**Lecture - Tutorial-Practice:**	4-0-0
Prerequisites:	14EC3507	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Acquainted with optical fiber waveguide transmission through SM & MM fibers
	CO2	Ability to analyze characteristics of optical fiber & to comprehend various fiber optic components.
	CO3	Familiarwith basics of LEDs, LASER Diodes&Optical Detectors and study their characteristics.
	CO4	Evaluate and design analog and digital optical fiber communication system & be aware of various optical fiber measurements.Empathize with various optical fiber networks.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	M											
	CO2	M											
	CO3	M											
	CO4			M									

Course Content

UNIT - I

Introduction: Historical Development, General System, Advantages of Optical fibers, Advantages of optical fiber Communication

Optical Fiber Waveguides: Ray Theory Transmission, Electromagnetic Mode Theory for Optical Propagation, Cylindrical Fibers, Single mode Fibers

	UNIT - II **Transmission Characteristics of Optical Fibers:** Introduction, Attenuation, Material Absorption Losses in Silicon Glass Fibers, Linear Scattering Losses, Non Linear Scattering Losses Fiber Bend Loss, Dispersion intramodal Dispersion, Intermodal Dispersion, Overall Fiber Dispersion. Dispersion in Single Mode Fibers Polarization. **Fiber Optic Components:** Fiber Alignment & Joint Loss, Fiber Splices, Fiber Connectors, Expanded beam connectors **UNIT - III** **Optical Sources – LED:** Introduction, LED Power& Efficiency, LED Structures LED Characteristics. **Optical Sources – LASER:** Basic Concepts, Optical Emission from semiconductors, Semiconductor Injection Laser, Laser Structures, Single Frequency Injection Lasers **Detectors:** Introduction, Optical Detection Principles, Absorption, Quantum's Efficiency, Responsivity, Semiconductor Photo Diode with internal gain, Semiconductor Photo Diode without internal gain **UNIT - IV** **Optical Fiber System:** Optical Transmitter Circuits, Optical Receiver Circuits Digital Systems, Digital System Planning Considerations, Analog Systems Advanced multiplexing Strategies **Optical Fiber Measurements:** Introduction, Attenuation Measurement, Dispersion Measurement, Refractive Index, Optical Time Domain Reflectometry **Optical Networks:** Optical network concepts, Optical network transmission modes, layers & protocols, Wave length routing networks, Optical switching networks, Repeaters

Text books and Reference books	**Text Books:** **1.** John M Senior, "Optical Fiber Communications: Principles and Practice", 3rd edition, 2002, PHI, (Units - I, II, III & IV) **Reference Books:** 1. Gerd Keiser, "Optical Fiber Communication", 3rd edition, 2003, Mc Graw Hill. 2. Kolimbiris, "Fiber Optics Communication", 1st edition, 2003, McGraw Hill, Prentice Hall. 3. Djafar K Mynbaev and Lowell L. Scheiner, "Fiber Optic Communication Technology", 2006, Pearson Education.
E-resources and other digital material	*1.* http://nptel.iitm.ac.in/courses/117101002/ *2.* http://*www.photonics.cusat.edu/links_optical_communications.html* *3.* http://www.cdeep.iitb.ac.in/nptel/Electrical &CommEngg /Optical Communication *4.* http://groups.csail.mit.edu/Miller.On-Chip-Optical-Communications.ppt

14EC4705/2: SATELLITE COMMUNICATION

Course Category:	**Program Elective**	**Credits:**	3
Course Type:	**Theory**	**Lecture - Tutorial -Practice:**	4-0-0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	To introduce the fundamental concepts and Orbital aspects involved in the field of satellite communications.											
	CO2	To train the students about the earth and space subsystems.											
	CO3	To introduce Power budget calculation Satellite system and services provided											
	CO4												
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M -Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	M											
	CO2	M											
	CO3	M											
	CO4	M											
Course Content	**UNIT I: Introduction:** Background, Brief History of Satellite communications, Satellite Communication in 2000, Overview of Satellite Communications **Orbital Mechanics and Launchers:** Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, Orbital effects in communication systems performance. **UNIT II: Satellite Subsystems:** Attitude and Orbit Control System (AOCS), Telemetry, Tracking, Command and Monitoring (TTC&M), Power Systems, Communication Subsystems, Satellite antennas, Equipment reliability and Space qualification. **Satellite Link Design:** Basic transmission theory, system noise temperature and G/T ratio, Design of downlinks, uplink design,												

	Design of satellite links for specified C/N. **UNIT III:** **Multiple Access:** Frequency division multiple access (FDMA), Time division Multiple Access (TDMA), Code Division Multiple access (CDMA) **VSAT Systems:** Introduction, Overview of VSAT Systems, Network Architectures, Access control protocols, Basic Techniques, VSAT Earth Station Engineering, Calculation of Link Margins for a VSAT Star network, System Design Procedure **UNIT – IV:** **Direct Broadcast Satellite Television and Radio:** Digital DBS TV, DBS TV System Design, DBS TV Link Budget Error Control in Digital DBS T, Master Control Station and Uplink, Installation of DBS TV Antennas
Text books and Reference books	**Text Books:** 1. Timothy Pratt, Charles Bastian and Jeremy Allnutt, "Satellite Communications", WSE, Wiley Publications, 2nd Edition, (Unit I, II, III & IV) **Reference Books:** 1. Dennis Roddy. (1996), "Satellite Communications", McGraw Hill, 2nd Edition. 2. D.C Agarwal, "Satellite Communication", 3rd Edition, Khanna Publications.
E-resources and other digital material	1.http://nptel.ac.in/courses/117105131/

14EC4705/3: DIGITAL TELEVISION

Course Category:	Program Elective	**Credits:**	3
Course Type:	**Theory**	**Lecture - Tutorial -Practice:**	4-0-0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the fundamentals of Television Engineering
	CO2	Understand the principles of Digital TV formats
	CO3	Understand HDTV standards and systems
	CO4	Analyze the various consumer applications

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

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	POk	PO l
CO1	M											
CO2	M											
CO3	M											
CO4	M											

Course Content

UNIT 1

INTRODUCTION: Raster images – Quantization – Image structure – Brightness and contrast – Raster scanning – Resolution – Introduction to luma and chroma. Composite video signal, and channel bandwidth

Color TV systems, colour fundamentals, mixing of colors, color perception

UNIT 2

Digital TV : Introduction to Digital TV, Principle of Digital TV, Digital TV signals and parameters, Digital TV Transmitters, MAC signals, advanced MAC signal transmission, Digital TV receivers, Basic principles of Digital Video compression

	techniques, MPEG1, MPEG2, MPEG4. **UNIT 3** **HDTV :** HDTV standards and systems, HDTV transmitter and receiver/encoder, Digital TV satellite Systems, CCTV, CATV - Digital CATV networks and link with DBS satcom, DTH TV, set top box with recording facility **UNIT 4** **Consumer Applications** Colour TV Digital cameras, Display devices: OLED – Working , LCD – Working , Types, Touch screen technology - Woking principle, Blue Ray DVD Player,3D TV systems – Plasma, LCD
Text books and Reference books	**Text Books** 1. Philip J. Cianci, "HDTV and the Transition to Digital Broadcasting: Understanding New Television Technologies", Focal Press, 2007. 2. Iain E. G. Richardson, "H.264 and MPEG-4 and Video compression video coding for Next-generation Multimedia", John Wiley & Sons Ltd., 2003 3. Television and video Engineering, A. M. Dhake, Tata McGraw Hill Publication. 4. Video Demisified, Kelth jack, Penram International Publication. **Reference Books** 1. S. P. Bali, "Color TV Theory and Practice", McGraw Hill Publications. 2. Bernard Grob, Charles E, "Basic TV and Video Systems" McGraw Hill Publications. 3. Gulathi, "Monochrome & Color TV", New Age International Publications.
E-resources and other digital material	1. http://www.nptelvideos.com/video.php?id=571 2. http://nptel.ac.in/courses/117104020/Lecture/Lec4.pdf

14EC4705/4 AD HOC NETWORKS

Course Category:	**Program Elective**	**Credits:**	3
Course Type:	**Theory**	**Lecture - Tutorial -Practice:**	4-0-0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Exemplify the unique issues in ad-hoc wireless networks
	CO2	Familiar current technology trends for the implementation and deployment of wireless adhoc networks
	CO3	Confer the challenges in designing MAC, routing and transport protocols for wireless adhoc networks
	CO4	--

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	POk	PO l
	CO1	M											
	CO2	M											
	CO3	M											
	CO4	M											

Course Content	**UNIT 1** INTRODUCTION TO ADHOC NETWORKS: Origin of Ad hoc Packet Radio Networks – Technical Challenges – Architecture of PRNETs – Components of Packet Radios, Ad hoc Wireless Networks – What is an Ad Hoc Network? Heterogeneity in Mobile Devices – Wireless Sensor Networks – Traffic Profiles – Types of Ad hoc Mobile Communications – Types of Mobile Host Movements – Challenges Facing Ad hoc Mobile Networks – Ad hoc wireless Internet. **UNIT 2** MAC PROTOCOLS FOR AD HOC NETWORKS: Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks – Classifications of MAC Protocols-MACA,MACAW– Power aware routing protocols **UNIT 3** **Routing Protocols For Ad Hoc Networks :**Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks – Classifications of Routing Protocols -Table-driven protocols – DSDV – CGSR – On-Demand protocols – DSR – AODV. **Multicast Routing**: Introduction – Issues in Designing a Multicast Routing Protocol – Operation of Multicast Routing Protocols – An Architecture Reference Model for Multicast Routing Protocols. **UNIT 4** **TCP over Ad Hoc:** TCP protocol overview, TCP and MANETs, and Solutions for TCP over Ad hoc. **Security:** Security in ad hoc networks, Key management, Secure routing, Cooperation in MANETs.

Text books and Reference books	**Text Books:** 1. C. Siva Ram Murthy and B. S. Manoj, ―Ad Hoc Wireless Networks Architectures and Protocols, Pearson, 2015. **Reference Books:** 1. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000 2. C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002 **3.** Mohammad Ilyas, The handbook of adhoc wireless networks, CRC press, 2002
E-resources and other digital material	www.it.**iit**b.ac.in/~sri/**talks**/manet.ppt

14EC4705/5: EMBEDDED SYSTEMS using RTOS

Course Category:	**PROGRAM-ELECTIVE**	**Credits:**	4
Course Type:	**THEORY**	**Lecture - Tutorial -Practice:**	4-0-0
Prerequisites:	**CO, MP&MC**	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Get insight of design metrics of Embedded systems to design real time applications to match recent trends in technology.
	CO2	Understand Real time systems concepts.
	CO3	Understand Linux operating system and device drivers.
	CO4	Get to know the hardware – software co design issues and testing methodology for Embedded system.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1		M	M									
	CO2		M	M									
	CO3		M	M									
	CO4		M	M									

Course Content	**Unit I:** **Introduction to Embedded Systems** Introduction to Embedded Systems, processor embedded into a system, embedded hardware units and devices in a system, embedded software in a system, complex systems design and processors, design process in embedded system, formalization of system design, design process, classification of embedded systems

	Unit II: Devices and communication buses for device network IO types, serial communication devices, parallel device pots, sophisticated interfacing features in device ports, wireless devices, timers and counting devices, watchdog timers, real time clock, networked embedded sytems, serial bus communication protocols, parallel bus device protocols. **UNIT III** **Real Time Operating Systems** Tasks, Task states, concept of semaphores, shared data, interprocess communication, singal function, semaphore functions, message queue functions, mailbox functions, pipe functions socket functions. OS services, process management, timer functions event functions, memory management, real time operating system, Basic design using an RTOS, OS security issues. **Unit IV** **µCOS II** Features of µCOS II. Kernel structure. µCOS II RTOS services: Task management, Time management, Event control blocks, semaphore management, mutual exclusion semaphores, event flag management, message mailbox management
Text books and Reference books	**Text Books:** 1. Frank Vahid and Tony Givargis, " Embedded System Design – A Unified hardware/Software introduction " 3rd edition, Wiley 2. Jean J.Labrosse, "MicroC OS II, The Real-Time Kernel", 2nd edition, CMP Books. **Reference Books** 1. Raj Kamal, "Embedded Systems – Architecture, Programming and Design" 2nd edition, McGraw Hill. 2. David E Simon" An Embedded Software Primer " pearson, 2004
E-resources and other digital material	1. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur /Embedded%20systems/New_index1.html 2. http://onlinevideolecture.com/?course_id=519 3. http://www.nptelvideos.in/2012/11/real-time-systems.html **4.** www.cse.iitd.ernet.in/~suban/csl373/rtos.ppt

14EC4706/1 :SPEECH PROCESSING

Course Category:	**Program Elective**	**Credits:**	3
Course Type:	**Theory**	**Lecture - Tutorial -Practice:**	4-0-0
Prerequisites:	**Digital Signal Processing**	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Describe the characteristics of speech signals and explain the principles of human speech production											
	CO2	Analyze the time domain and frequency domain representation of speech signal											
	CO3	Apply Linear Predictive Coding (LPC) to speech synthesis system											
	CO4	Build a complete speech recognition system using state of the art tools											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	POk	PO l
	CO1	M											
	CO2	M											
	CO3	M											
	CO4	M											
Course Content	**UNIT I:** **Digital Models For The Speech Signal**: The Process of Speech Production – Acoustic Theory of Speech Production – Lossless Tube Digital Models For Speech Signals **Time Domain Models For Speech Processing** : Time Dependent Processing of Speech-Short Time Energy & Average Magnitude, Zero Crossing Rate, Pitch Period Estimation Short Time Auto Correlation Function , Median Smoothing and Speech Processing.												

	UNIT II: **Short Time Fourier Analysis** Basic Model Short Time Analysis and Synthesis of Speech , Implementation of Filter Bank Summation Methods Using FFT , Pitch Detection , Analysis – By-Synthesis, Analysis-Synthesis Systems. **UNIT III:** **Homomorphic Speech Processing:** Complex Cepstrum Approach, Pitch Detection Formant Detection, Homomorphic Vocoder. **Linear Predictive Coding Of Speech:** Principles of Linear Predictive Analysis, Solution of LPC Equation ; Prediction Error Signal, Frequency Domain Representation of LPC Analysis Relation Between the Various Speech Parameter Synthesis of Speech from LP Parameters and Applications. **UNIT – IV** **Man-Machine Communication**: Speaker Recognition System-Speaker Verification Systems, Speaker Identification Systems, Speech Recognition System-Isolated Digit Recognition System-Continuous Digit Recognition System-LPC Distance Measures-Large Vocabulary Word Recognition System.
Text books and Reference books	**Text Books:** 1. L.R. Rabiner and R.E Schafer, "Digital Processing of Speech Signals", Pearson Education, 2008, (Unit I, II, III & IV) **Reference Books:** 1. Thomas Quatieri, "Discrete – Time Speech Signal Processing ", 2001, Prentice Hall. 2. Lawrence Rabiner, Biing – Hwang Juang, B Yegnanarayana, "Fundamentals of Speech Recognition", 2009, Pearson Education
E-resources and other digital material	1. http://www.ee.imperial.ac.uk/hp/staff/dmb/courses/speech/speech.htm 2. http://www.ee.ic.ac.uk/hp/staff/dmb/courses/speech/speech.htm

14EC4706/2: DIGITAL IMAGE PROCESSING

Course Category:	**Institutional core**	**Credits:**	4
Course Type:	**Theory**	**Lecture - Tutorial-Practice:**	4-0-0
Prerequisites:	**Signals and systems** **Linear algebra**	**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 fundamentals of image, various operations and relation between pixels.
	CO2	Improve the quality of images using spatial and frequency domain filtering techniques of image enhancement and restoration.
	CO3	Design the various techniques used for image compression and segmentation with their applications.
	CO4	Understand the fundamentals of Morphological andcolor image processing with color models.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	POi	PO j	POk	PO l
	CO1	H				L						L	
	CO2	H				H						M	
	CO3	M				H						M	
	CO4	H				L						M	

Course Content

UNIT I:

Digital Image Fundamentals: Fundamental Steps and Components of Image Processing, Applications, Elements of visual perception, Image sampling and quantization, basic relationships between pixels, Arithmetic & Logical operations on Images.

UNIT II:

Image Enhancement: Basics of intensity transform, Histogram

	Processing, Spatial Filters. Image Enhancement in Frequency Domain Filters Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering. **Image Restoration**: A Model of the Image Degradation/ Restoration Process, Linear Position-Invariant Degradations, Inverse filtering, Minimum Mean Square Error (Wiener) Filter, Constrained Least squares filtering. **UNIT III:** **Image Compression:** Fundamentals, Image Compression Models, Elements of Information Theory, Error Free Compression, Lossy Compression. Compression using DCT. **Image segmentation:** Detection of Discontinuities, Edge Linking and Boundary Description, Thresholding, Region Based Segmentation. K-means clustering, Watershed segmentation algorithm, Segmentation using NDVI, Principle Component Analysis methods. **UNIT – IV:** **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, Hit-orMiss Transform, Some Basic Morphological Algorithms **Colour Image Processing:**Color Fundamentals**,**Colour models-RGB, CMY & CMYK, HSI, YIQ, Color Conversions Pseudo color Image Processing, Full Color Image Processing.
Text books and Reference books	Text Book: Gonzalez and Wood, "Digital Image Processing", 3rd Edition, Pearson Education.(Units- I,II,III & IV) Reference Books: 1. Jayaraman S , Veerakumar T , Esakkirajan S"Digital Image Processing", 2009, McGraw Hill Education. 2. Anil K. Jain, "Fundamentals of Digital Image Processing", 2003, Pearson Education.
E-resources and other digital material	1. http://nptel.ac.in/courses/117105079/ 2. http://nptel.ac.in/courses/106105032/ 3. http://nptel.ac.in/courses/117104069/

14EC4706/3: BIOMEDICAL INSTRUMENTATION

Course Category:	Program 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	Ability to apply the knowledge of biomedical sciences in medical instrumentation by identifying the electrophysiology of heart brain, nerves, & muscles.
	CO2	Ability to identify the transducers electrodes and recorders used for different bio potentials like ECG, EEG, EMG, EOG, ERG, EGG and also different blood flow techniques.
	CO3	Ability to understand the basic circuit involved in blood gas analyzers, x-rays, ct-scans, ultra sounds used in medicine.
	CO4	Able to differentiate between external pacemakers and implantable pacemakers and will get familiarity with defibrillators, artificial kidney dialyzes and different diatherapy techniques.

		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	POk	PO l
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)	CO1	M											
	CO2	M											
	CO3	M											
	CO4	M											

Course Content

UNIT – I

Bioelectric Potentials, Electrodes and Transducers: Sources Bioelectric potentials - Resting and action potential - Propagatio action potential Electrode theory- Equivalent circuit- Types electrodes. Physiological Transducers: Inductive, Capacit Piezoelectric Transducers and Thermistors. Biochemical Transduc pH, pCo2 and pO2 electrodes.

	UNIT – II **Electrophysiological Measurements:** Electrophysiology of He Nervous system and Muscle activity. Bio-signals: ECG - E Evoked potential - EMG- ERG- Electrodes and lead system, typ waveforms and signal characteristics. Signal Conditioning Circu Design of low noise medical amplifier, Isolation amplifier, Protec circuits and Electrical safety. **Non-Electrical Parame Measurements:** Measurement of blood pressure, Blood fl Plethysmography, Cardiac Output, Heart Sounds - Lung volumes their measurements - Auto analyzer - Blood cell counters, Oxy saturation of Blood. **UNIT – III** **Medical Imaging Techniques:** X-ray machine - Compu Tomography - Angiography - Ultrasonography - Magnetic Resonar Imaging System - Nuclear imaging techniques - Thermography Lasers in Medicine - Endoscopy. UNIT – IV **Telemetry, Assist and Therapeutic Devices:** Bio telemetry Elements and Design of Bio telemetry system. Assist and Therapeu devices: Cardiac pacemakers - Defibrillators - Artificial heart valve Artificial Heart Lung machine - Artificial Kidney - Nerve and Mus Stimulators - Respiratory therapy equipment - Patient Monitori System
Text books and Reference books	**Text books:** 1. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeifer. (2006), "Biomedical Instrumentation and Measurement", 2nd edition, Pearson Education.(Units - I, II, III) 2. M. Arumugam. (1997), "Biomedical Instrumentation", 2nd edition, Anuradha Agencies Publications.(Unit - IV) **Reference books:** 1. R. S. Khandpur. (2006), "Handbook of Biomedical Instrumentation", 2nd edition, Tata McGraw Hill. 2. John G. Webster, (2007), "Medical Instrumentation Application and Design", 3rd edition, Wiley India
E-resources and other digital material	1. http://en.wikipedia.org/wiki/Biomedical_engineering 2. http://www.bmesi.org.in/

14EC3751: DIGITAL SIGNAL PROCESSING LAB

Course Category:	**Programme core**	**Credits:**	2
Course Type:	**Practical Lab**	**Lecture - Tutorial -Practice:**	0-0-3
Prerequisites:	**Signal And Systems & Digital Signal Processing**	**Continuous Evaluation:**	30M
		Semester end Evaluation:	70M
		Total Marks:	100M

<table>
<tr><td>Course outcomes</td><td colspan="12">Upon successful completion of the course, the student will be able to:</td></tr>
<tr><td></td><td>CO1</td><td colspan="11">To Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of Analog and digital filter types like IIR-Butterworth, Chebyshev, Bilinear, Impulse invariant, FIR window-design</td></tr>
<tr><td></td><td>CO2</td><td colspan="11">To develop DSP algorithms like convolution, correlation, DFT, DIT FFT, DIF FFT in software using a computer language such as C with TMS320C6713 floating point Processor</td></tr>
<tr><td rowspan="3">Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)</td><td></td><td>PO a</td><td>PO b</td><td>PO c</td><td>PO d</td><td>PO e</td><td>PO f</td><td>PO g</td><td>PO h</td><td>PO i</td><td>PO j</td><td>POk</td><td>PO l</td></tr>
<tr><td>CO1</td><td>H</td><td>L</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>H</td><td></td></tr>
<tr><td>CO2</td><td>H</td><td>H</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>H</td><td></td></tr>
<tr><td>Course Content</td><td colspan="12">1. a.Sampling theorem verification.
b.Determination of Fourier transform, Auto correlation, and PSD of Periodic signal.
c.Determination of Fourier transform, Autocorrelation, and PSD of aperiodic signal.
2. Butterworth and Chebyshev IIR filter design using Bilinear Transformation
3. Butterworth and Chebyshev IIR filter design using Impulse In-variance Method.
4. Design of FIR filters using windowing Technique</td></tr>
</table>

	a.rectangular window b.hanning window c.hamming window 5. Design of FIR filters using windowing Technique A.barttlet window B.blackmann window C.kaiser window 6. DIT FFT Algorithm. 7. DIF FFT Algorithm 8. Decimation and Interpolation 9. Implementation of FIR filter on continuous incoming data using overlap add and overlap save method **Code Composer Studio** 10. ASK, FSK, PSK waveform generation 11. Linear and Circular convolution. 12. Correlation 13. DFT & IDFT. 14. Design of FIR filters using windowing Technique
Text books and Reference books	1. Alan Oppenheim, Discrete time signal processing, Prentice Hall, 2009, 1120pp. 2. Proakis and Manolakis, Digital signal processing, 4th edition, Prentice Hall, 2006. 1004pp.
E-resources and other digital material	1.http://vlab.co.in/ba_labs_all.php?id=1 2.http://web.stanford.edu/class/ee264/ 3.http://dsp.rice.edu/software

14EC3752: MICROPROCESSORS AND MICROCONTROLLERS LAB

Course Category:	Programme core	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial -Practice:**	0-0-3
Prerequisites:	14EC3503 Microprocessors and Microcontrollers	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Develop assembly language programs on 8086 and 8051.											
	CO2	Interface the peripherals to 8086 and 8051.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M -Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	POk	PO l
	CO1			H	H								
	CO2			H	H								
Course Content	**List of lab Exercises:** **Experiments Based on 8086:** 1. Programs on Arithmetic and Logical instructions of 8086. 2. Programs on Subroutines of 8086. 3. Programs on Interrupts.(Software and Hardware). 4. Programs on DAC Interface waveform generation. 5. Programs on Stepper motor control. 6. Programs on ADC Interface. **Experiments Based on 8051:** 1. Basic programs on Microcontrollers. 2. Programs on Serial Communications. 3. Programs on Interrupt Mechanism. 4. Programs on Timer/Counter concepts. 5. Programs on LCD Display interfacing. 6. Programs on Traffic Light Control. 7. Programs on Keyboard interface.												

NB: A minimum of 10(Ten) experiments (5 from each section) have to be performed and recorded by the candidate to attain eligibility for External Practical Examination

14EC3801: MICROWAVE ENGINEERING

Course Category:	**Core**	**Credits:**	4
Course Type:	**Theory**	**Lecture - Tutorial -Practice:**	4
Prerequisites:	**Electromagnetic Field Theory& Transmission lines and Waveguides**	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the generation & amplification of the microwave signals and Setup microwave bench at X-band, obtain the characteristics of Reflex Klystron
	CO2	Design and develop the passive components for microwave systems, obtain the characteristics of these components.
	CO3	Analyze the reciprocal and nonreciprocal devices at microwave frequencies.
	CO4	Analyze the transmission line problems and Measure VSWR, Unknown impedance & Gain of an antenna

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

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	POk	PO l
CO1	M											
CO2	M	L	L									
CO3			L	L								
CO4				M								

Course Content

UNIT I: MICROWAVE LINEAR BEAM TUBES (O-type): Limitations of Conventional Tubes at Microwave Frequencies, Klystron: Velocity Modulation Process. Bunching Process, Output Power and Beam Loading, Reflex Klystron: Velocity Modulation, Power Output and Efficiency, Electronic Admittance.

Helix Traveling Wave Tube Amplifiers, Amplification Process, Wave Modes and Gain Considerations (Qualitative analysis only). **Microwave Crossed Field Tubes** (M Type): Cylindrical

	Magnetron, Forward Wave Crossed Field Amplifier, Backward Wave Oscillator **UNIT II: MICROWAVE PASSIVE COMPONENTS:** Waveguide Adapters, Matched Termination, Rectangular to Circular Waveguide Transitions, Waveguide Corners, Bends and Twists, Attenuators and Phase Shifters: waveguide attenuators, wave guide phase shifters, Waveguide Tees - E-plane Tee, H-plane Tee, Magic Tee and their applications, Tee Junction Parameters, Theorems on Tee Junctions, Introduction to S parameters ,Properties of S parameters, S matrix of representation of multi port network, S Matrix derivation for all components, Propagation in ferrites, Ferrite Devices, Faraday Rotation Isolator, Gyrator, Circulator, Directional Couplers, Coupler Parameters, Applications of Directional Couplers. Microwave Resonators: waveguide Cavity Resonators, Cavity Excitation and Tuning. **UNIT III: SOLID STATE DEVICES**: Gunn-Effect Diodes - GaAs Diode, Gunn Effect, Ridely-Watkins-Hilsun (RWH) Theory, Differential Negative Resistance, Two-Valley Model Theory, High-Field Domain, Modes of Operation, **Avalanche Transit-Time Devices**: Read Diode, Physical Description, Avalanche Multiplication, Carrier Current Io(t) and External Current Ie(t), Output Power and Quality Factor, IMPATT Diodes, Physical Structures, Negative Resistance, Power Output and Efficiency, TRAPATT Diodes, Physical Structures, Principles of Operation, Power Output and Efficiency, BARITT Diodes, Physical Description, Principles of Operation, Parametric Devices, Parametric Amplifiers, Applications. **UNIT – IV MICROWAVE MEASUREMENTS**: Power Measurement, Insertion Loss and Attenuation Measurement, Impedance Measurement , Slotted line VSWR measurement, VSWR through return loss measurements, Frequency Measurement, Measurements of Q of Cavity, Measurement of Scattering Parameters. **Antenna Measurements**: Gain and Directivity measurement, Impedance measurement, Radiation Pattern measurement.
Text books and Reference books	1. Samuel Y.LIAO : Microwave Devices and Circuits - Prentice Hall of India - 3rd Edition (2003) (Units -I&III) 2. Annapurna Das and Sisir K.Das: Microwave Engineering - Tata McGraw-Hill (2000) (Units -II&IV)

	Reference Books: 1. E. Collin : Foundations for Microwave Engg. - IEEE Press Second Edition (2002) 2. David M. POZAR : Microwave Engg. - John Wiley & Sons - 2nd Edition (2003)
E-resources and other digital material	1. http://technology.niagarac.on.ca/courses/elnc1730/microsolid.ppt 2. http://www.intechopen.com//passive_microwave_components_ana_antenna 3. http://home.sandiego.edu/~ekim/e194rfs01/ 4. http://www.slideshare.net/sarahkrystelle/lecture-notes

14EC4802/1: SEMICONDUCTOR DEVICE MODELING

Course Category:	**Program Elective**	**Credits:**	3
Course Type:	**Theory**	**Lecture - Tutorial-Practice:**	4-0-0
Prerequisites:	**Electronic Devices, Electronic Circuits**	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand the concepts of semiconductor device physics.											
	CO2	Analyze the BJT and FET device structure and characteristics.											
	CO3	Understand the second order effects of BJT and MOSFET.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	POi	PO j	POk	PO l
	CO1	H	H										
	CO2	M	M										
	CO3	M	M										
Course Content	**UNIT I:** Energy bands in solids, Electrons and holes densities in equilibrium, Excess carriers – Non-equilibrium situation, Mobility of carriers: Effect of electric filed on carrier movement, Effect of temperature and doping on carrier mobility, Effect of high electric field on mobility, Diffusion Current, Einstein's Relation connecting μ and D.**(12hrs)** **UNIT II:** Bipolar Junction Transistors: Introduction, Principle of Operation, Current Components in a BJT, Approximate expressions for currents in Normal Active Mode of Operation, Basic BJT parameters, The Ebers-Moll Model, Capacitances in a BJT, Switching of Bipolar Transistors. Operation of BJT at high frequencies, Design of high frequency transistors, Second order effects in BJTs, Variation of beta with collector current, high												

	injection in collector, heavy doping in emitter, Non-conventional BJTs, Hetero-junction Bipolar Transistors (HBT).**(18hrs)** **UNIT III:** Metal-semiconductor junction, Energy band diagram of M-S junction, Current-voltage characteristics of M-S junction, Ohmic contacts, The MESFETs, The Hetero- junction FETs.MOS Diode: Operation of the Ideal MOS Diode, Operation of the MOS Diode with $\Phi_{ms}\neq 0$, $Q_{ox}=0$, Operation of the MOS Diode with $\Phi_{ms}\neq 0$, $Q_{ox}\neq 0$, C-V Characteristics of the MOS Diode (Capacitor)**(14hrs)** **UNIT – IV** The MOSFET, Threshold Voltage of MOSFET, Above Threshold I-V Characteristics of MOSFETs, Bulk Charge Model (Level 2 in SPICE), Square Law Model (Level 1 in SPICE), MOSFET Level 3 Model in SPICE,Effect of gate and drain voltages on carrier mobility in the inversion layer, Channel length modulation, MOSFET break down and punch-through, Subthreshold current, MOSFET scaling, Non-uniform doping in channel, Threshold voltage of short channel MOSFETs, Other MOSFETs configuration.**(14hrs)**
Text books and Reference books	**Text Books:** 1. Nandita Das Gupta, Amitava Das Gupta (2004), "Semiconductor Devices Modelling and Technology", Prentice Hall India.(UNIT I - IV) **Reference Books:** 1. B. G. Streetman and S. Banerjee, Solid State Electronic Devices, 6th Edition, PHI Private Limited, 2011. 2. Y. Tsividis, Operation and Modeling of the MOS transistor, 2nd edition, TMH, 1999. 3. G. Massobrio and P. Antognetti, Semiconductor Device Modeling with SPICE, 2nd Edition, TMH, 2010. 4. Introduction to Semiconductor Materials and Devices – Tyagi M. S, 2008, John Wiley StudentEdition. 5. Introduction to Device Modeling and Circuit Simulation – Tor A. Fijedly, Wiley-Interscience, 1997. 6. S. A. Neamen and D. Biswas, Semiconductor Physics and Devices, 4th Edition, TMH, 2012. 7. S. M. Sze and K. K. Ng, *Physics of Semiconductor Devices*, 3rd Edition, Wiley India, 2010.
E-resources and other digital material	1. http://nptel.ac.in/courses/117106033/ 2. https://nanohub.org/resources/5749 3. https://www.coursera.org/learn/mosfet

14EC4802/2 LOW POWER VLSI DESIGN

Course Category:	**Program Elective**	**Credits:**	3
Course Type:	**Theory**	**Lecture - Tutorial -Practice:**	4-0-0
Prerequisites:	**Electronic Devices, Electronic Circuits**	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Apply different circuit techniques to manage the leakage currents											
	CO2	Comprehend existing low power adder and multiplier architectures											
	CO3	Understand the architectural and circuit level techniques for attaining low power consumption											
	CO4												
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1			M		M							
	CO2			M		M							
	CO3			M		M							
Course Content	**UNIT I** **Low power CMOS VLSI design -** Introduction, sources of power dissipation, static power dissipation, active power dissipation. **Circuit techniques for low power design -** Introduction, designing for low-power, circuit techniques for leakage power reduction. (12) **UNIT II** **Low voltage low power adders -** Introduction, standard adder cells, CMOS adder's architectures, low voltage low power												

	design techniques, current mode adders. **Low voltage low power multipliers -** Introduction, overview of multiplication, types of multiplier architectures, braun multiplier, baugh-wooley multiplier, booth multiplier, wallance tree multiplier. (12) **UNIT III** **Low voltage low power static RAM -** Basics of SRAM, memory cell, precharge and equalization circuit, decoder, address transition detection, sense amplifier, output latch, low power SRAM technologies. **Low voltage low power dynamic RAM -** Types of DRAM, basics of DRAM, self refresh circuit, half voltage generator, voltage down converter, future trends and developments of DRAM. (14) **UNIT IV** **Low- Voltage Low Power Read-Only Memories -** introduction, types of ROM, basics physics of floating gate nonvolatile devices, floating gate memories, basics of ROM, low power ROM Technology. (10)
Text books and Reference books	**Text Books** 1. Kiat Seng Yeo, Kaushik Roy (2005),"Low Voltage, Low Power VLSI Subsystems", TATA McGraw-Hil. **Reference Books** 1. Yeo Rofail,Gohl (2002)," CMOS/BiCMOS ULSI Low Voltage, Low Power", Pearson Education Asia 1st Indian reprint. 2. J.Rabaey (1996), "Digital Integrated circuits: a Design Perspective", PHI.
E-resources and other digital material	1. http://www.facweb.iitkgp.ernet.in/~apal/LPVRG%20website/resourses.htm

14EC4802/3 CMOS IC DESIGN

Course Category:	**Program elective**	**Credits:**	3
Course Type:		**Lecture - Tutorial -Practice:**	4
Prerequisites:	**Electronic Devices, Electronic Circuits**	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Evaluate the performance of CMOS Inverter in terms of area, power and speed.											
	CO2	Evaluate the performance and power consumption of contemporary gate logic families											
	CO3	Design and analyze single stage amplifiers and differential amplifiers											
	CO4												
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1			M		M							
	CO2			M		M							
	CO3			M		M							
	CO4												
Course Content	**UNIT I:UNIT I** **The CMOS Inverter -** Static CMOS Inverter, Static Behaviour, Performance of CMOS Inverter: Dynamic Behaviour, Power, Energy, and Energy- Delay, Technology Scaling and its Impacts on the Inverter Metrics. **UNIT II** **Designing Combinational Logic Gates in CMOS -** Static CMOS Design – Complementary CMOS, Ratioed Logic, Pass Transistor Logic, Dynamic Logic: Basic Principle, Speed and												

	Power Dissipation of Dynamic Logic, Issues in Dynamic Design, Cascading Dynamic Gates. **UNIT III:** **Designing Sequential Logic Circuits -** Introduction, Static Latches and Registers, Dynamic Latches and Registers, Pipelining: An approach to Optimize Sequential Circuits , Timing Classification of Digital Systems, Synchronous Interconnect, Synchronous Design **UNIT – IV** **MOS Single Stage and Differential Amplifiers -** Basic concepts, Common-Source stage, Common-Source stage with resistive load, Common-Source with diode connected load, Common-Source Triode load, Common-Source stage with source degeneration, Source follower, common gate stage ,, Single ended and differential operation, Basic differential pair: Qualitative analysis and Quantitative analysis , Basic current mirrors
Text books and Reference books	**Text Books:** 1. Jan M. Rabaey, Anantha P. Chandrakasan, Borivoje Nikolic, (2003) "Digital Integrated Circuits: a Design Perspective", 2nd Edition, Pearson Education. 2. Behzad Razavi (2002), 'Design of Analog CMOS Integrated Circuits' Tata-McGrawHill. **Reference Books:** 1. J. Uyemura (1992), Circuit Design for CMOS VLSI, Kluwer. 2. A. Kang and Leblebici, (1999) CMOS Digital Integrated Circuits, 2nd Ed., McGraw-Hill. 3. David A Johns & Ken Martin (2001), "Analog Integrated Circuit Design" John Wiley and Sons.
E-resources and other digital material	1. http://nptel.ac.in/courses/117106030/

14EC4802/4: EMBEDDED SYSTEMS using RTOS

Course Category:	**Program-Elective**	**Credits:**	4
Course Type:	**THEORY**	**Lecture-Tutorial-Practice:**	4-0-0
Prerequisites:	**CO, MP&MC**	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Get insight of design metrics of Embedded systems to design real time applications to match recent trends in technology.											
	CO2	Understand Real time systems concepts.											
	CO3	Understand Linux operating system and device drivers.											
	CO4	Get to know the hardware – software co design issues and testing methodology for Embedded system.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1		M	M									
	CO2		M	M									
	CO3		M	M									
	CO4		M	M									
Course Content	**Unit I:** **Introduction to Embedded Systems** Introduction to Embedded Systems, Architecture, Classification and Characteristics of Embedded System, Design Process, Design Metrics and optimization of various parameters of embedded system. Embedded processor technology, IC technology, Design technology. Software development life cycle. Various models like waterfall, spiral, V, Rapid Prototyping models and Comparison. **Unit II:** **Real Time Systems Concepts** Foreground/ Background systems, Critical section of code, Resource,												

	Shared resource, multitasking, Task, Context switch, Kernel, Scheduler, Non-Preemptive Kernel , Preemptive Kernel, Reentrancy, Round robin scheduling, Task Priorities, Static & Dynamic Priority, Priority Inversion, Assigning task priorities, Mutual Exclusion, Deadlock, Clock Tick, Memory requirements, Advantages & disadvantages of real time kernels. **µCOS II** Features of µCOS II. Kernel structure. µCOS II RTOS services: Task management, Time management, Intertask Communication and Synchronization. **Unit III:** **Embedded Linux Development Environment** Need of Linux, Embedded Linux Today, Open Source and the GPL, BIOS Versus Boot loader, Anatomy of an Embedded System, Storage Considerations, Embedded Linux Distributions. Embedded Development Environment, Cross-Development Environment, Host System Requirements, Hosting Target Boards. Development Tools, GNU Debugger, Tracing and Profiling Tools, Binary Utilities. **Unit IV:** **Linux Kernel Construction**, Linux Kernel Background, Linux Kernel Construction, Kernel Build System, Kernel Configuration. Role of a Bootloader, Bootloader Challenges. A Universal Bootloader: Das UBoot. Porting U-Boot. Device Driver Concepts, Module Utilities, Driver Methods. Linux File System & Concepts **Embedded Software Development**: Testing Process and Tools, Embedded Software development process and tools, Host and Target Machines, linking and Locating Software, Getting Embedded Software into the Target System.
Text books and Reference books	**Text Books:** 3. Jean J.Labrosse, “MicroC OS II, The Real-Time Kernel”, 2nd edition, CMP Books. 4. Christopher Hallinan, “Embedded Linux Primer -A Practical,

	Real-World Approach ”2nd edition, Prentice Hall. **Reference Books** 3. Raj Kamal, “Embedded Systems– Architecture, Programming and Design" 2nd edition, McGraw Hill. 4. Frank Vahid and Tony Givargis, “Embedded System Design - A Unified hardware/Software introduction ” 3rd edition, Wiley.
E-resources and other digital material	5. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Embedded%20systems/New_index1.html 6. http://onlinevideolecture.com/?course_id=519 7. http://www.nptelvideos.in/2012/11/real-time-systems.html **8.** www.cse.iitd.ernet.in/~suban/csl373/rtos.ppt

14EC3803/1: RADAR PRINCIPLES

<table>
<tr><td rowspan="4">Course outcomes</td><td colspan="13">Upon successful completion of the course, the student will be able to:</td></tr>
<tr><td>CO1</td><td colspan="12">Know the principles and applications of RADAR</td></tr>
<tr><td>CO2</td><td colspan="12">Interpret the concepts of Doppler Effect, range measurement and detection of signals in noise.</td></tr>
<tr><td>CO3</td><td colspan="12">Analyze tracking with radar and can choose receiver, display and duplexer for the applications</td></tr>
<tr><td rowspan="4">Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)</td><td></td><td>PO a</td><td>PO b</td><td>PO c</td><td>PO d</td><td>PO e</td><td>PO f</td><td>PO g</td><td>PO h</td><td>PO i</td><td>PO j</td><td>PO k</td><td>PO l</td></tr>
<tr><td>CO1</td><td>M</td><td></td><td>L</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td>M</td><td></td><td>L</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td>M</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Course Content</td><td colspan="13">UNIT I:

INTRODUCTION TO RADAR: Basic Radar –The simple form of the Radar Equation- Radar Block Diagram and operation-Applications of Radar –The Radar Equation - Detection of Signals in Noise- Receiver Noise and the Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm-Integration of Radar Pulses- Radar Cross Section of Targets- Radar cross Section Fluctuations- Transmitter Power-Pulse Repetition Frequency- Antenna Parameters-System losses

UNIT-II:

MTI Radar: Introduction to Doppler and MTI Radar- Delay – Line Cancelers- Staggered Pulse Repetition Frequencies – Doppler Filter Banks - Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance - MTI from a Moving Platform (AMTI)</td></tr>
</table>

	UNIT III: **Pulse Doppler Radar** - Tracking with Radar –Monopulse Tracking –Conical Scan and Sequential Lobing - Limitations to Tracking Accuracy - Low-Angle Tracking - Tracking in Range - Other Tracking Radar Topics -Comparison of Trackers - Automatic Tracking with Surveillance Radars (ADT). Radar Antennas- **UNIT IV:** **Detection of Signals in Noise** –Introduction – Matched –Filter Receiver –Detection Criteria – Detectors –-Automatic Detector - Integrators - Constant-False-Alarm Rate Receivers - The Radar operator - Signal Management - Propagation Radar Waves - Atmospheric Refraction -Standard propagation - Nonstandard Propagation - The Radar Receiver - Receiver noise Figure – Super heterodyne Receiver - Duplexers and Receiver Protectors- Radar Displays.
Text books and Reference books	1. Merrill I Skolnik, Introduction to Radar Systems, 3rd edition, TMH, 2003 **Reference Books:** 1. Roger J Suullivan, "Radar Foundations for Imaging and Advanced Topics". 2. Peyton Z Peebles Jr. (2004), "Radar Principles", John Wiley Inc.,
E-resources and other digital material	1. http://ocw.mit.edu/resources/res-ll-003-build a small-radar-system-capable-of-sensing-range-doppler-and-synthetic-aperture-radar-imaging-january-iap-2011/lecture-notes/ 2. http://www.radartutorial.eu/07.waves/wa04.e n.html

14EC4803/2: ADVANCED WIRELESS COMMUNICATIONS

Course Category:	**Program Elective**	**Credits:**	3
Course Type:	**Theory**	**Lecture - Tutorial -Practice:**	4-0-0
Prerequisites:	**Mobile & Cellular Communications**	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Realize Wireless LAN design and operations.											
	CO2	Explain the structure and components for Mobile IP and Mobility Management											
	CO3	Differentiate Traditional TCP and Classical TCP improvements											
	CO4	Analyze the Fourth Generation systems and New Wireless Technologies											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	M											
	CO2	M											
	CO3	M											
	CO4	M											
Course Content	**UNIT I:** **Wireless LAN:** Introduction-WLAN technologies: Infrared, UHF narrowband, spread spectrum -IEEE802.11: System architecture, protocol architecture, physical layer, MAC layer, 802.11b, 802.11a. Bluetooth: Architecture, Radio Layer, Baseband layer, Link manager Protocol, security – IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX.												

14EC3803/3: EMI/EMC		**UNIT II:** **Mobile Network Layer:** Introduction – Mobile IP: IP packet delivery, Agent discovery, tunnelling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol – mobile ad-hoc network: Routing, Destination Sequence distance vector, Dynamic source routing. **UNIT III:** **Mobile Transport Layer:** TCP enhancements for wireless protocols – Traditional TCP: Congestion control, fast retransmit/fast recovery, Implications of mobility – Classical TCP improvements: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, Transaction oriented TCP – TCP over 3G wireless networks**.** **UNIT – IV** **Fourth Generation Systems and New Wireless Technologies:** Introduction – 4G vision, 4G features and challenges – Applications of 4G, 4G Technologies: Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO systems, Adaptive Modulation and coding with time slot scheduler, Cognitive Radio
	Text books and Reference books	**Text Books:** 1. Jochen Schiller, "Mobile Communications", II Edition, Pearson Education 2012. (Unit I, II, III). 2. Vijay Garg , "Wireless Communications and Networking", I Edition, Elsevier 2007. (Unit IV) **Reference Books:** 1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Second Edition, Academic Press, 2008. 2. Kaveh Pahlavan, Prasanth Krishnamoorthy, "Principles of Wireless Networks", PHI/Pearson Education, 2003.
	E-resources and other digital material	3. https://www.doc.ic.ac.uk/~nd/surprise_95/journal/vol2/mjf/article2.html 4. http://www.cisco.com/c/en/us/td/docs/ios/solutions_docs/mobile_ip/mobil_ip.html 5. https://www.eeweb.com/blog/purnendu_kumar/fourth-generation-wireless-technology

Course	**Elective**	**Credits:**	3

Category:			
Course Type:	**Theory**	**Lecture - Tutorial -Practice:**	4
Prerequisites:	**Electromagnetic Field Theory**	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Gain enough knowledge to understand the concept of EMI / EMC related to product design & development.
	CO2	Analyze the different EM coupling principles and its impact on performance of electronic system.
	CO3	know how to bring down the electromagnetic interference highlighting the concepts of both susceptibility and immunity
	CO4	Analyze various EM compatibility issues with regard to the design of PCBs and ways to improve the overall system performance.

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

	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
CO1	M											
CO2		L										
CO3	M											
CO4		L										

Course Content

UNIT:I EMI / EMC Concepts: EMI-EMC definitions and Units of parameters, Sources and victim of EMI, Conducted and Radiated EMI Emission and Susceptibility, Transient EMI, ESD, Radiation Hazards.

UNIT:II EMI Coupling Principles: Conducted, radiated and transient coupling, Common ground impedance coupling, Common mode and ground loop coupling, Differential mode coupling , Near field cable to cable coupling, cross talk , Field to cable coupling ; Power mains and Power supply coupling.

UNIT: III EMI Control Techniques: Shielding- Shielding Material-Shielding integrity at discontinuities Filtering-

	Characteristics of Filters-Impedance and Lumped element filters-Telephone line filter, Power line filter design, Filter installation and Evaluation, Grounding- Measurement of Ground resistance-system grounding for EMI/EMC-Cable shielded grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control. EMI gaskets. **UNIT: IV EMC Design of PCBs:** EMI Suppression Cables-Absorptive, ribbon cables-Devices-Transient protection hybrid circuits, Component selection and mounting, PCB trace impedance; Routing, Cross talk control Electromagnetic Pulse-Noise from relays and switches, Power distribution decoupling; Zoning, Grounding, VIAs connection, Terminations.
Text books and Reference books	1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, Newyork, 1996. **REFERENCE BOOKS:** 1. Henry W.Ott.,"Noise Reduction Techniques in Electronic Systems", A WileyInter Science Publications, John Wiley and Sons, Newyork, 1988. 2. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Ed, Artech house, Norwood, 1986. 3. C.R.Paul,"Introduction to Electromagnetic Compatibility", John Wiley and Sons, Inc, 1992. 4. Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC", Vol I-V,1988.
E-resources and other digital material	1. http://www.nptel.ac.in/courses/117101057/

14EC3803/4: ELECTRONIC NAVIGATION

Course Category:	**Core Elective**	**Credits:**	3
Course Type:	**Theory**	**Lecture - Tutorial -Practice:**	3
Prerequisites:	**Antennas and wave propagation & Microwave engineering, Radar**	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Know the principles of Navigation and direction finding Techniques.											
	CO2	Understand the operational principle of Navigation equipment.											
	CO3	Analyze the satellite navigation and hyperbolic navigation systems											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M -Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	M		L									
	CO2	M		L									
	CO3	M											
Course Content	**UNIT I: Introduction** - Four methods of Navigation .**Radio Direction Finding** - The Loop Antenna - Loop Input Circuits - An Aural Null Direction Finder - The Goniometer - Errors in Direction Finding - Adcock Direction Finders - Direction Finding at Very High Frequencies - Automatic Direction Finders – The Commutated Aerial Direction Finder - Range and Accuracy of Direction Finders **UNIT II: Radio Ranges** - The LF/MF Four course Radio Range - VHF Omni Directional Range(VOR) - VOR Receiving Equipment - Range and Accuracy of VOR – Recent Developments. Hyperbolic Systems of Navigation (Loran and Decca) - Loran-A - Loran-A Equipment- Range and precision of Standard Loran - Loran-C - The Decca Navigation System -Decca Receivers - Range and Accuracy of Decca - The Omega System.												

	UNIT – III DME and TACAN - Distance Measuring Equipment - Operation of DME - TACAN -TACAN Equipment. Aids to Approach and Landing - Instrument Landing System - Ground Controlled Approach System - Microwave Landing system(MLS) **UNIT IV: Doppler Navigation** - The Doppler Effect - Beam Configurations -Doppler Frequency, Equations - Track Stabilization - Doppler Spectrum - Components of the Doppler Navigation System - Doppler range Equation - Accuracy of Doppler Navigation Systems. **Inertial Navigation** - Principles of Operation - Navigation Over the Earth – Components of an Inertial Navigation System - Earth Coordinate Mechanization - Strapped-Down Systems - Accuracy of Inertial Navigation Systems. Satellite Navigation System - The Transit System - Navstar Global Positioning System (GPS).
Text books and Reference books	1. N S Nagaraja, "Elements of Electronic Navigation", 2nd Edition, TMH **Reference Books:** 1. Dr A K Sen and Dr AB Bhattacharya, Radar Systems and Radio Aids to Navigation, Khanna Publishers, 1988.
E-resources and other digital material	1. http://www.aimforhigh.in/2011/11/ec2049-radar and-navigational-aid anna.html#ixzz32nENDwDQ

14EC3851: MICROWAVE ENGINEERING LAB

Course Category:	**Program Core**	**Credits:**	2
Course Type:	**Lab**	**Lecture - Tutorial -Practice:**	0-0-3
Prerequisites:	**Transmission lines and Waveguides & Antennas and wave propagation**	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the lab course, the student will be able to:												
	CO1	measure the characteristics of microwave oscillators											
	CO2	Deduce the characteristics and parameters of microwave passive components											
	CO3	Measure the characteristics of optical sources, detectors and measure the various losses of the fiber.											
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO i	PO j	PO k	PO l
	CO1	H	L									H	
	CO2	H	H									H	
	CO3	H	L									H	
Course Content	1. characteristics of Reflex klystron oscillator 2. characteristic of Gunn diode oscillator 3. Obtain the properties of E and H Plane Tees. 4. Measure the scattering parameters of directional coupler/magic Tee/ circulator 5. Measurement of High and Low VSWR for the given load 6. Measurement of gain & directivity of the given horn antenna 7. Measurement of directional pattern & beam width of the horn antenna. 8. Verification of expression $1/\lambda_0^2 = 1/\lambda_c^2 + 1/\lambda_g^2$.												

	9. Measurement of the input impedance and attenuation for the given device. 10. Obtain the V-I characteristics of Optical sources and detectors 11. Study of propagation and bending loss of the optical fibers 12. Study of numerical aperture and attenuation measurement
	13. Measurement of dielectric constant of a given material 14. Set up of time division multiplexing using fiber optics